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JPRS-UEE-86-003

1 MAY 1986

# USSR Report

## ELECTRONICS AND ELECTRICAL ENGINEERING

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USSR REPORT  
ELECTRONICS AND ELECTRICAL ENGINEERING

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ANTENNAS AND PROPAGATION

UDC 535

FIELD AROUND FOCUS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 8 Dec 83) pp 1469-1482

KINBER, B. Ye. and NOVOSELOV, S. V.

[Abstract] The field around a focus is analyzed according to the geometrical theory of diffraction. The case of  $C_0 = ka^2/f < 10$  ( $k$  - wave number,  $a$  - aperture dimension,  $f$  - focal length)<sup>0</sup> is considered, which corresponds to an optical instrument focused on a point at infinity or at least very far within the Fraunhofer region so that the field pattern is geometrical rather than quasi-optical. The integral representation of such a field for the two-dimensional scalar problem in the Kirchhoff approximation is reduced to one for the axisymmetric scalar problem with synphasal toroidal Huygens sources, the field being generally asymmetric with respect to the focal plane and having a single-cavity hyperboloidal rather than tubular pattern. The singularities of such a field, its extremum points and edge rays, are constructed for the three possible limiting superpositions of the three principal waves: 1) all three waves in phase; 2) two edge waves in phase, geometrical wave in antiphase; 3) one edge wave and geometrical wave in phase, other edge wave in antiphase. The distribution of illumination intensity is taken into account in a uniform asymptotic expansion of the field, for determination of the distance through which the point of maximum field intensity shifts away from the focus but not quite into the aperture plane and for determining the ratio of that maximum field intensity to the field intensity at the focus. The authors thank R. B. Baganov and B. Z. Katsenelenbaum for helpful discussion. Figures 6; references 8: 6 Russian, 2 Western (1 in Russian translation).

[66-2415/5915]

UDC 537.874.6

ANALYSIS OF NUMERICAL SOLUTION TO DIFFRACTION PROBLEM FOR SINGLE-LAYER AND DOUBLE-LAYER DIELECTRIC CYLINDERS WITH LARGE RADIUS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 17 Nov 83) pp 1483-1493

VORONTSOV, A. A., DYACHENKO, M. I. and MIROVITSKAYA, S. D.

[Abstract] Diffraction of plane waves by single-layer and double-layer dielectric circular cylinders with a radius of the order to  $10^3$  wavelengths is considered, asymptotic summation of series being the most expedient method of numerically calculating the light intensity distribution in the far field from the exact analytical solution to the corresponding Maxwell equations. That solution in trigonometric series with coefficients usually expressible in terms of Bessel and Hankel functions is modified here by expressing the coefficients in terms of three special functions, namely ratio of Bessel functions  $J_{m+1}/J_m$ , ratio of Neumann functions  $N_{m+1}/N_m$ , and ratio of Bessel function to Neumann function  $J_m/N_m$ . The algorithm is different for single-layer cylinders and for double-layer cylinders, it simplifies somewhat for thin dielectric cylinders. It has been programmed in FORTRAN and was applied to an optical fiber 160  $\mu\text{m}$  in diameter and incident light of the  $\lambda = 0.63 \mu\text{m}$  wavelength. Calculation of 256 points of the diffraction pattern by this method on a BESM-6 high-speed computer required only 30 s, while calculation by the conventional method on an IBM-360/50 computer required 30 min. Figures 9; references 12: 6 Russian, 1 Czechoslovak, 5 Western (2 in Russian translation). [66-2415/5915]

UDC 537.8

HELICON BEAMS OF ELECTROMAGNETIC WAVES WITH ZERO DIFFRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 15 Feb 84) pp 1494-1496

YANKAUSKAS, Z. K.

[Abstract] While electromagnetic radiation cannot be transmitted in parallel beams through free space without diffraction and consequent beam widening, unless the radiation wavelength is extremely small and the aperture (beam cross-section) is infinitely large, in a magnetized solid-state plasma helicon beams of electromagnetic radiation can exist which are not diffracted and thus do not diverge. This is demonstrated by solving the wave equation which derives from the corresponding three Maxwell field equations and the equation of helicon propagation through a magnetic field in a Cartesian system of coordinates. That wave equation is solved not in the conventional parabolic approximation but exactly and in a cylindrical system of coordinates. The exact solution describes a channel with radial symmetry and zero diffraction-related divergence. The description simplifies appreciably in the important

practical case of a strong constant magnetic field. The theoretically predicted existence of such a channel has been confirmed experimentally, with helicon waves in a magnetized electron plasma excited by an alternating current in a circular wire loop. Figures 1; references: 3 Russian.  
[66-2415/5915]

UDC 537.871.5

MODIFICATION OF POLARIZATION SPHERE FOR REPRESENTATION OF PARTIALLY POLARIZED ELECTROMAGNETIC WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 24 Apr 84) pp 1497-1504

ZHIVOTOVSKIY, L. A.

[Abstract] A modification of the Poincare sphere is proposed which will facilitate comprehensive analysis of partially polarized or superposed non-coherent waves. Application of the Stokes theorem is replaced by introduction of a 4-dimensional polarization sphere as the parametric space. The construction of such a sphere is based on the more general theory for visualization of an n-dimensional sphere, considering that any n-dimensional Euclidean space can be represented as the direct sum of orthogonal  $k_j$ -dimensional ( $1 \leq k_j \leq n$ ) subspaces, with  $n = 4$  then treated as a special case. This sphere facilitates solution of such a problem as determining the parameters of the resultant wave produced by addition of noncoherent waves as well as solution of the reverse problem, namely finding the various sets of nonnegative-definite Hermitian matrices whose sum will yield a given positive-definite Hermitian matrix. Any real wave only partially polarized will correspond to some point on the left-hand hemisphere so that the distance from such a wave to a receiver antenna and the distances between different such waves can be easily determined. The right-hand hemisphere can, meanwhile, be used for representation and analysis of  $2x2$  Hermitian matrices of any definiteness. Figures 4;  
references 8: 6 Russian, 2 Western (1 in Russian translation).  
[66-2415/5915]

## EFFECT OF INTERMITTENCY OF ATMOSPHERIC TURBULENCE ON SCATTERING OF RADIO WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
 (manuscript received 1 Jun 84) pp 1531-1537

GURVICH, A. S. and KUKHARETS, V. P.

[Abstract] Aerial measurements of high-frequency temperature fluctuations in the atmosphere responsible for scattering of ultrashort radio waves, indicate that atmospheric turbulence is intermittent rather than continuous. This intermittency is analyzed according to the theory of radio wave scattering in an atmosphere whose turbulence parameters are random functions of the radius vector. In the approximate expression for the energy flux density in a scattered wave, turbulence is represented as fluctuations of the refractive index: "fast" and "slow" fluctuations produced by two different mechanisms. The resultant effect of both is considered, "fast" fluctuations of the refractive index being caused by interference of waves with random amplitude and phase after their scattering in different places within the scattering volume and "slow" fluctuations of the refractive index being caused by variation of the turbulence intensity within that volume. All possible realizations of the refractive index profile are treated as a statistically "mixed" set from which a "pure" set can be extracted according to some criterion based on the turbulence intensity characteristic within that scattering volume, assuming that "fast" and "slow" fluctuations are two statistically independent processes. The three-dimensional spectrum of index fluctuations within the inertia range is assumed to be determined by two external factors, namely the rate of dissipation of kinetic energy and the rate of index profile smoothing. The probability of the energy flux density exceeding some fixed level and the probabilities of energy flux densities high above that level are then calculated, assuming a known probability density of the energy flux density. The reverse problem, determining the quantitative characteristics of turbulence intermittency from sufficiently many measurements of the energy flux density is solved by first calculating the moments  $\langle \bar{c}_n^2 \rangle^m$  of the structural characteristic  $\bar{c}_n^2$  in the "pure" set as a function of the order  $m$  and of the scattering volume  $V$ . Numerical estimates have been obtained accordingly, assuming a log normal probability distribution of the random quantity  $\bar{c}_n^2$  as a simple and convenient model. Inclusion of turbulence intermittency in these estimates explains the appearance of point echo-signals. Figures 2; references 13: 5 Russian, 8 Western (1 in Russian translation).

[66-2415/5915]

UDC 621.396.67.095

POLARIZATION CHARACTERISTIC OF MICROSTRIP ANTENNAS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 15 Mar 84) pp 1538-1542

PANCHENKO, B. A.

[Abstract] The polarization characteristic of microstrip antennas are calculated, considering that a laminar dielectric and a two-dimensional radiator worsen that characteristic with interference signals already generated by cross-polarization or another parasitic component of the electromagnetic field. The radiation polarization characteristic of an antenna is defined as the complex quantity  $P(\theta, \phi) = E_{\text{par}}(\theta, \phi)/E_{\text{pri}}(\theta, \phi) = |P(\theta, \phi)|e^{-j\phi(\theta, \phi)}$  ( $E_{\text{par}}, E_{\text{pri}}$  - parasitic and principal field components,  $\theta, \phi$  - spherical coordinates). This characteristic is calculated first for two linearly polarized antennas, a rectangular one and a discal one. A rectangular in a plane at a large elevation angle, not far from vertical, and a rectangular one with shorted edge on the load side are of special interest. The effect of a laminar dielectric is taken into account by the current method, with an electric current sheet above the dielectric layer replacing the metal plate. Next are considered the same rectangular and discal antennas with circular polarization of emitted radiation. Figures 3; references 5: 2 Russian, 3 Western.  
[66-2415/5915]

UDC 621.396.96

RADAR EQUATION INCLUDING NONLINEAR ABSORPTION AND ASPECT SCATTERING OF WAVES BY INHOMOGENEITIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 11 Mar 84) pp 1656-1657

MOZHAYEV, A. A.

[Abstract] The radar equation  $P_s = \frac{\sigma \cdot PGAF^4(v, \phi)}{(4\pi r)^2}$  ( $P_s$  - power of received signal,  $\sigma$  - effective scattering area of target,  $PG$  - effective power of transmitter,  $\sigma$  - effective scattering area of target,  $A$  - effective area of radar antenna,  $F^4(v, \phi)$  - radiation pattern of radar antenna,  $r$  - distance from target) is modified for ionospheric probing by inclusion of another factor  $10^{-0.1\gamma}r$  to account for absorption of waves. Here  $\gamma = \gamma_1 + \gamma_n + \gamma_a$  is the absorption index with  $\gamma_1$ ,  $\gamma_n$ , and  $\gamma_a$  representing respectively linear absorption, nonlinear absorption dependent on the wave field intensity in the ionosphere, and absorption caused by aspect scattering. This factor can be further refined by treating the overall absorption index as the sum of those characterizing the dominant absorption mechanism in each ionospheric layer. Figures 1; references: 3 Russian.  
[66-2415/5915]

UDC 621.3.011

CALCULATION OF SHAPE OF ANTENNA ELECTRODE AREA FORMED BY ELECTRIC FIELD

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 6, Jun 85 (manuscript received 26 Oct 82) pp 13-16

STADNIK, I. P., MILYUKOV, V. V., KOSHELEV, V. A., KULIKOV, S. P. and  
CHEREDNICHENKO, I. I.

[Abstract] An algorithm was suggested in an earlier work for optimization of the geometric parameters and control voltages of an antenna formed by an electric field with a fixed plane shape for the electrode area. For small distances between the membrane and electrode area, significant voltages arise between neighboring control electrodes, leading to significant heterogeneity of distribution of charge on the electrodes and to great deviations in the synthesized force from that assigned at points on the membrane close to the interelectrode gap. This can be avoided by two means: increasing the distance between the electrode area and the membrane, and changing the shape of the electrode area, i.e., seeking a placement of electrodes such that they are at approximately identical potential and create the required electrostatic pressure on the membrane. This article discusses the second method. Figure 1, references 2: 1 Russian, 1 Western.

[25-6508 /5915]

UDC 621.317.343:621.396.67

SYNTHESIS OF LINEAR COLLIMATOR ANTENNA FOR OPERATION IN FRESNEL REGION

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received 14 Jun 84) pp 13-18

KRITSKIY, S. V. and NOVOSARTOV, M. T.

[Abstract] A collimator antenna for measuring the radiation pattern of another antenna in its Fresnel region is synthesized, taking into consideration that modern transmitter and receiver antennas are not only large but have apertures with very unequal height and width. The problem of designing a collimator antenna, a mirror or a lens which should be much larger than the tested antenna, can be solved differently by use of a linear collimator and its placement in the far-field region relative to the smaller dimension of the tested antenna. The expression for the amplitude-phase distribution in such a collimator includes two phase factors, one to account for path deviation from a circular arc and one to account for focusing of the aperture. The correctness of design calculations for a linear mirror collimator has been verified by means of a waveguide-slot radiator of length  $L = 12\lambda$  ( $\lambda$  - radiation wavelength) having oblique slots cut in one of the narrower walls with an alternating pitch so as to minimize the dominant oscillating error component in measurement of side lobes of an antenna with the latter rotated through large angles. Figures 7; tables 1; references: 7 Russian.

[80-2415/5915]

UDC 621.396.677.83

DESIGN OF SCHEME FOR IMPROVED CASSEGRAIN ANTENNA

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 5 Dec 84) pp 40-44

DAVYDOV, A. G. and SHALYAKIN, A. I.

[Abstract] An improvement of the Cassegrain antenna has been proposed (USSR patent disclosure 1,109,838), namely shaping the active surface of the small reflector into a hyperboloid around a cone at the center so as to minimize the scattering of plane waves from the large reflector. This will not only increase the gain but also improve the matching with a feeder waveguide. The active surface of the large reflector will be generated by revolution of two parabolic segments, a principal one and a corrective one, so that the focal axis of the principal paraboloid be the axis of symmetry, as in the conventional Cassegrain antenna, and its focus coincide with the nearer focus of the hyperboloid. The focal axis of the corrective paraboloid will be parallel to the axis of symmetry and its focus will be offset from that focus of the hyperboloid. The field produced by the horn between the two reflectors and reflected by the cone of the small reflector will then not cover the shadow zone of the large reflector but the adjacent to it correction zone. The design of such an antenna is analyzed on the basis of an electrodynamic model in which the small reflector is infinitesimally thin and ideally conducting, this reflector picking up an external field  $E^0, H^0$  which approximates the field produced by a real horn. The corresponding problem of diffraction is reduced to a system of two rigorous integrodifferential equations in a spherical system of coordinates and then solved by numerical methods on a computer. The results yield the radiation amplitude and phase patterns of the small reflector in the secondary field, also the gain increment over the gain of a conventional antenna and the side-lobe level as functions of the cone angle. On this basis can be selected the optimum cone angle, generally a tradeoff. The authors thank Ye. V. Zakharov, V. I. Klassen and Yu. V. Pimenov for attentiveness and helpful suggestions. Figures 4; references: 4 Russian..  
[80-2415/5915]

UDC 621.396.677

VECTOR DIAGRAMS IN DIFFERENCE CHANNEL OF PARABOLIC ANTENNAS WITH REFLECTOR HAVING TWO PLANES OF SYMMETRY

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85 (manuscript received 15 Aug 84)  
pp 44-47

NARBUT, V. P.

[Abstract] Reflectors having two planes of symmetry rather than axial symmetry only are considered for improving the polarization pattern of parabolic antennas not only in the sum channel but also in the difference channel. The vector diagram for such antennas in the difference channel is determined using

an electric dipole and a magnetic dipole as etalons of antennas with only main polarization and with only cross-polarization respectively. Calculations by the composite asymptotic method for optical antennas and with transformation from spherical to rectangular coordinates have been verified experimentally for antennas with an elliptic reflector aperture. The thus obtained space patterns of both polarizations in both polarization and direction-finding planes, characterized by the width of their major lobes and the location of their first peaks as well as by their slopes, indicate that cross-polarization is reduced by replacement of an axisymmetric reflector with a bisymmetric one. The cross-polarization attenuates faster with a reflector eccentricity  $e < 1$ , but the directive gain for the main field component also decreases. The directive gain for the main field component remains almost uniform with a reflector eccentricity  $e > 1$ , but the cross-polarization attenuates slower. With a reflector eccentricity  $e = 1$  the pattern is unstable, a slightest deviation or unbalance producing cross-polarization. Figures 5; references: 3 Russian.  
[80-2415/5915]

UDC 621.391.828:621.396.677.83

#### DECOUPLING OF ANTENNAS AT EDGE OF CONDUCTING HALF-PLANE

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 11 Feb 85) pp 47-50

LOMUKHIN, Yu. L., BADMAYEV, S. D. and CHIMITDORZHIYEV, N. B.

[Abstract] An experimental study was made with use of diffracting shields for electromagnetic decoupling of microwave antennas located at the edge of a conducting half-plane. Two identical antennas, open ends of waveguides with  $10 \times 23 \text{ mm}^2$  cross-section, were placed facing each other  $15 \lambda_0$  apart at the same  $40 \lambda_0$  long edge of a  $40 \lambda_0$  long and  $15 \lambda_0$  wide metal plate ( $\lambda_0$  - wavelength of electromagnetic radiation). Tests were performed with various polarizations of the electromagnetic field, electromagnetic radiation at the  $\lambda_0 = 3.2 \text{ mm}$  wavelength being generated by a G4-109 or G3-28 oscillator and the field intensity being measured with a P5-34 receiver. The results indicate that, while the edge effect inhibits decoupling by an annular shield between two antennas, interference of the primary field with the reradiated field aids decoupling by lobate shields. For maximum decoupling, such shields should be oriented with their plane parallel or perpendicular to the line joining the two antennas, depending on whether the E-component or the H-component of the electromagnetic field is parallel to the edge of the metal plate. Figures 4; references: 5 Russian.  
[80-2415/5915]

UDC 621.396.67

CURRENT DISTRIBUTION AND EFFECTIVE SCATTERING SURFACE AREA OF  
IMPEDANCE DIPOLE

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 19 Feb 85) pp 50-52

FILIMONOV, A. A.

[Abstract] The one-dimensional integro-differential equation with a small parameter-multiplier for the current distribution in a cylindrical impedance dipole is solved by the method of perturbations, according to the theory of slot antennas, for zero-current boundary conditions at both ends. The solution is accurate down to the terms of first-order smallness in that parameter and remains valid for any ratio of cylinder length to radiation wavelength. Such a solution is obtained for the special case of a dipole with synphasal excitation and it not only describes the current distribution but also yields the field backscattered by the dipole. The effective scattering surface area of a dipole is very easily calculated for normal incidence of the exciting field and for oblique incidence of a plane exciting wave. This has been done numerically for an ideally conducting dipole and a copper one by this method and by other methods. The difference in the magnitude of the effective scattering surface area does not exceed 10% and depends mainly on differences in describing the resonance curve, the difference in maximum effective scattering surface area not exceeding 5%. Figures 1; references 13: 7 Russian, 6 Western (1 in Russian translation).

[80-2415/5915]

UDC 621.375.029.64:621.396.67

NOISE CHARACTERISTICS OF BALANCED MICROWAVE AMPLIFIER FOR ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85 (manuscript received 12 Dec 84)  
pp 52-55

BABENKO, A. I., ZAYTSEV, E. F. and STATSENKO, V. V.

[Abstract] An evaluation of a balanced low-noise amplifier pair for phased receiver antenna arrays is made, such a pair consisting of two identical amplifiers connected between two 3 dB directional couplers. From their scattering matrices and noise-temperature matrices are calculated the performance and noise characteristics of the pair, with two equivalent incident-wave generators identified as separate circuit components of the pair. Assuming that the noises in the two amplifiers are noncorrelated, a dummy load in one arm of the directional coupler on the input side is included as an additional noise source. The equivalent intrinsic noise temperature of the antenna array is calculated as a function of the modulus of the complex reflection coefficient on the radiator side, considering the most critical condition of a mismatch with the radiators as signal sources. For a full evaluation of the amplifier noise, it

is calculated not only for a balanced pair but also for each amplifier in a plain connection tuned to a minimum noise factor and then with a decoupling diode connected before each. Figures 4; references 8: 7 Russian, 1 Western.  
[80-2415/5915]

UDC [621.371:551.510.621.373.826]01

#### THERMAL DISTORTIONS OF LASER PULSE IN ATMOSPHERE

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 12 Jun 81) pp 1249-1256

GORDIN, M. P., SADOVNIKOV, V. A. and STRELKOV, G. M.

[Abstract] The propagation of a pulse Gaussian beam over vertical and oblique atmospheric paths is modeled numerically. The bleaching capability of the beam, which determines its depth of penetration into an aerosol, is analyzed. It is shown that, below 3 km, the atmosphere can cause significant thermal distortions of the pulse during the summer when going from vertical to oblique paths. Beam distortion caused by the atmospheric layer below clouds must be taken into account in estimating the pulse energy needed to disperse a cloud layer. The bleaching capability of a pulse beam can be increased at the cloud level by reducing the pulse length, which requires solving the problem of beam propagation through an aqueous aerosol under conditions of explosive droplet evaporation. Figures 7, references 14: 9 Russian, 5 Western.

[57-6900/5915]

UDC 535.417.2

#### FIELDS OF OPEN OPTICAL WIDE-APERTURE RESONATORS FORMED BY CONVEX AND CONCAVE MIRRORS

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 11 Jul 83) pp 1257-1266

MARCHENKO, V. G.

[Abstract] The fields of wide-aperture optical open resonators formed by concave and convex mirrors are investigated assuming that the influence of diffraction on the aperture diaphragms can be disregarded, and that the structure of the fields in wide-aperture resonators at a distance from the open edges is determined by the curvature and positioning of the mirrors; the aperture geometry determines the Q factor for the fields as well as the behavior of the fields near the open edges of the system. Analytical expressions are derived for the fields of unstable resonators by the method of separation of variables. The asymptotic representation of the paraxial fields of stable resonators coincides with the commonly accepted representation, which can be viewed as confirmation that the overall approach is valid. Figures 5, references 16: 13 Russian, 3 Western.

[57-6900/5915]

UDC [535.233:537.871.5]029.44

POLARIZATION OF THERMAL RADIATION OF RAIN IN CENTIMETER RADIO WAVE BAND

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 24 Oct 83) pp 1282-1287

REZNIK, A. N.

[Abstract] The polarization of the thermal radiation of a rainy atmosphere is investigated in centimeter band in order to assess the possibility of exploiting this effect to measure rain parameters. The equation describing the transfer of radiation in a flat stratified absorbing and scattering medium is derived and solved approximately for the case of spherical rain drops. Under the latter assumption, the polarization of atmospheric thermal radiation is governed by the scattering of electromagnetic waves in the rain, with the intensity of the effect depending upon the rain parameters. This indicates that the polarization effect can be used to estimate rain parameters, especially the optical thickness of the radiation scattering along the line of sight. The degree of radiation polarization is found as a function of the angle of observation, the wavelength, and the optical thickness of the atmosphere. Comparison with experimental data shows that rain parameters can be determined from the measured polarization of its radiation. Figures 2, references 9: 6 Russian, 3 Western.

[57-6900/5915]

UDC 621.391.26

COMPARISON OF THE EFFECTIVENESS OF SPACE SELECTION OF SIGNAL AND NOISE SOURCES DURING OPTIMAL AND MATCHED SIGNAL PROCESSING IN FRESNEL ZONE

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 30 May 83) pp 1341-1347

KREMER, I. Ya., PETROV, V. M. and SHAPIRO, S. M.

[Abstract] The effectiveness of suppression of interference created by several external noise sources is investigated as a function of the spatial cross-correlation between the interference signals. The suppression effectiveness is estimated by the signal/interference ratio at the processing system output. A comparison of the suppression effectiveness for optimal and or matched space-time signal processing for the case of several external noise sources is made. The formulas derived can be used in designing signal processing devices for multipositional radar systems to estimate the gain achieved by employing optimal (adaptive) instead of matched (nonadaptive) processing in the presence of numerous interfering sources, making it possible to identify the conditions under which it is justified to complicate the signal processing devices in order to implement optimal processing. Figures 4, references: 4 Russian.  
[57-6900/5915]

UDC 621.391

OPTIMAL METHOD FOR DETECTING AND DETERMINING DIRECTION OF RADIATION SOURCES  
WITH PARAMETRIC A PRIORI INDETERMINACY

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 30 Dec 82) pp 1348-1355

RYBAKOV, B. S.

[Abstract] A discrete-time detector for a one-dimensional Markov process developed earlier by the author is extended to the case of a two-dimensional vector Markov process for worst-case detection conditions--the absence of a regular signal component. Recursive algorithms are derived for the likelihood ratio and for filtering using an adaptive Bayesian approach, assuming that the signals and noise are described by a generalized Gaussian model with parametric a priori indeterminacy. The problem of joint detection and direction finding of radiation sources of two-dimensional Markov signals is solved. The structural diagram of the proposed optimal receiver is presented. Algorithms for generating the direction-finding system output voltage are presented as an example. Figures 1; references: 9 Russian.

[57-6900/5915]

UDC 621.396.677

RADIATION CHARACTERISTICS OF HYBRID REFLECTOR ANTENNA IN FREQUENCY BAND

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85 (manuscript received 29 Mar 85)  
pp 69-72

KLASSEN, V. I., TOBOLEV, A. K. and SHISHLOV, A. V.

[Abstract] The frequency properties of a hybrid reflector antenna with a parabolic reflector and a radiating array with its aperture in the constricted region of the beam incident on the reflector are considered. The analysis is performed for arrays with frequency-independent amplitude-phase distribution and aperture, which corresponds to a feed scheme with circuits with different lengths from the input of the array to each of its radiators. The findings are interpreted on the basis of geometric optics and the aperture approach. Formulas are derived for estimating the antenna characteristics within a band of frequencies. Figures 7, references: 5 Russian.

[102-6900/5915]

UDC 621.396.677.83

OPTIMAL PARAMETERS OF CASSEGRAIN ANTENNA

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 18 Feb 85 after revision) pp 72-74

KINBER, B. Ye. and EYDUS, A. G.

[Abstract] The optimal values of four basic Cassegrain antenna parameters--the distances from the feed to the apices of the large and small reflectors, the pattern width of the feed, and the ratio of the diameter of the large reflector to the focal length--are found on the basis of the maximum directional gain, i.e., the filter utilization coefficient of the antenna. An expression is derived for the directional gain that allows for energy leakage passed to the mirror, shading of the small reflector or feed, and illumination of the edge of the large reflector by the half-shadow field. References 4: 2 Russian, 2 Western.

[102-6900/5915]

UDC 621.396.3

INTERFERENCE FROM UNDERLYING SURFACE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 12 Mar 85 after revision) pp 75-76

MIKHEYEV, A. G. and RAKITIN, B. V.

[Abstract] Simple analytical expressions are derived for calculating the average value and temporal behavior of the clutter power received by the main beam of a pulse radar antenna. The clutter is shown to drop and become approximately equal to its average values when the antenna beam is raised and broadened, and when the height is increased. This is because the spot illuminated by the antenna beam on the underlying surface becomes significantly greater than the unambiguous range band, and the radar simultaneously receives echoes from several successive pulses with comparable power. The power of the echoes from each of the pulses exhibits its own temporal behavior, so that the latter is averaged when the echoes are added. Figure 1, references 6:

5 Russian, 1 Western.

[102-6900/5915]

UDC 621.396.6

INFLUENCE OF TYPE OF DETECTOR IN NONCOHERENT MOVING-TARGET INDICATION SYSTEM

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85 (manuscript received 5 Mar 85)  
pp 24-26

KISELOV, A. Z.

[Abstract] The relationship between the type of detector in a noncoherent moving-target indication system and the performance of the alternate-period compensation devices that extract the moving target signals against the clutter background is investigated. When the valid signal (and noise) are weaker than the clutter, the alternate-code compensation devices perform the same for linear and square-law detectors. If the valid signal is stronger than the clutter, the alternate-period compensation performance depends strongly upon the type of detection. Linear detectors are shown to suppress strong synthetically fluctuating signals from moving targets. Figures 1, references:

4 Russian.

[102-6900/5915]

UDC 621.396.679.4.01

ADAPTIVE ANTENNA SYSTEM FOR SEPARATING SIGNALS COMING FROM DIFFERENT DIRECTIONS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 18 Dec 84 after revision) pp 66-69

MOROZOV, A. K. and LITSAREV, N. A.

[Abstract] An adaptive antenna system based on the Davis pattern-forming scheme, which requires no pilot signal, is examined. The antenna automatically separates narrowband signals coming from different unknown directions. The antenna system consists of an antenna array, the pattern forming circuit (with  $N$  stages) and a controller. Each stage incorporates power dividers, phase inverters, four-port networks, and matched loads. Each stage produces only one maximum or a null of the radiation pattern if the distance between the elements of the array satisfy the inequality  $d \leq \lambda / (\cos \theta_1 - \cos \theta_2)$ , where  $\theta_1$  and  $\theta_2$  are the boundary values of the working range of angles of the array determined by the radiation pattern of an array element. The proposed adaptive system can be used to receive narrowband signals in multipath channels. Figures 5, references: 3 Russian.  
[102-6900/5915]

UDC 621.396.677.71

LONGITUDINAL SLOTS IN CYLINDRICAL MEMBER JOINING METAL SIDE PIECES FORMING  
WEDGE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 2 Feb 85 after revision) pp 63-66

KRAVTSOV, V. A. and ULASIK, O. L.

[Abstract] Analytical expressions are derived for the complex mutual conductances of longitudinal unilateral slots in a cylindrical member joining the two sides of a metal wedge. The external boundary problem of excitation of such a wedge along the edge of a narrow longitudinal slot is solved. The field distribution in the aperture of the slot is assumed to be constant and practically independent of external fields. The active and reactive components of complex mutual conductances are calculated as a function of the radius of the cylindrical joining member and the position of the slot with respect to one another on the cylindrical part of the wedge. Figures 2, references 6:

5 Russian, 1 Western.

[102-6900/5915]

UDC 533.951

TOWARD A KINETIC THEORY OF ELECTROMAGNETIC AND PLASMA WAVES IN SLIGHTLY  
IONIZED UNSTEADY PLASMA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28,  
No 9, Sep 85 (manuscript received 9 Oct 84) pp 1083-1089

BIRAGOV, S. B., MINDLINA, Ye. I. and STEPANOV, N. S., Gorkiy State University

[Abstract] Expressions are derived for the behavior of electromagnetic and plasma waves in a slightly ionized stationary unsteady plasma whose concentration changes over time due to ionization and recombination. The contribution of the fast collisions of electrons with heavy particles, and of spatial dispersion, are accounted for kinetically, while the ionization and recombination processes responsible for the change in electron concentration over time are described phenomenologically. Analytic solutions for the kinetic equations, and dispersion relationships for the electromagnetic and plasma waves, are obtained. The amplitude of the plasma wave as a function of time is investigated numerically for rapid variations of the plasma parameters. The wave amplitude is shown to drop off over time for all of the changes in electron concentration examined. Regardless of whether ionization or recombination predominates, neither of these processes in a resting plasma can cause an increase in the electromagnetic perturbations, and thus cause "gradient" instabilities. Figures 3, references 9: 8 Russian, 1 Western.

[103-6900/5915]

UDC 533.951

ENERGY AND ENERGY FLUX IN THEORY OF SMALL SCALE OSCILLATIONS OF COLD PLASMA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28,  
No 9, Sep 85 (manuscript received 4 Jun 84) pp 1090-1098

YEFIMOV, S. P., KAPCHINSKIY, M. I. and YUDIN, L. A.

[Abstract] A variational principle is formulated, within the framework of the linear theory, that allows the energy density and its flux to be found by differentiating the density of a Lagrange function. An approach is described for deriving the expressions for the components of the energy-pulse tensor directly from the linearized equation. It is found that the equilibrium state may be inhomogeneous and may exhibit local motion. A Lagrangian formalism is constructed for a hydrodynamic description of the plasma in external electromagnetic fields when the coordinates do not track the motion of the individual particles. The wave packet energy found under the linearized approach has the same value as the energy calculated on the same order of smallness from the exact nonlinear equations. The formalism and expressions derived for the energy-pulse tensor components may be useful in solving various problems of the linear theory of oscillations of a cold plasma. References 6: 4 Russian, 2 Western.

[103-6900/5915]

UDC 538.56:517.93:621.373

PHASE LOCKING AND BIFURCATIONS OF PHASE-LOCKED AND QUASIPERIODIC OSCILLATIONS  
IN NONAUTONOMOUS GENERATOR

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28,  
No 9, Sep 85 (manuscript received 7 May 84) pp 1112-1125

AKISHCHENKO, V. S., LETCHFORD, T. Ye. and SAFONOVA, M. A., Saratov State  
University

[Abstract] Mode restructuring regularities in a nonautonomous generator with inertial nonlinearity are investigated indirectly and physically through two-parameter analysis. A mathematical model of a nonautonomous generator assigned by a system of differential equations is presented and a physical analog of the system of equations is described that consists of an RC oscillator with a balanced Wein bridge and a negative feedback system incorporating a half-wave square-law detector and an RC smoothing filter. Typical bifurcations caused by losses of stability by the regular modes and the destruction mechanisms of the two-dimensional torus that lead to dynamic chaos are described. The system of equations derived demonstrates all of the typical transitions to chaos. Figures 8, references 27: 22 Russian, 5 Western.

[103-6900/5915]

UDC 537.874.6

ITERATIVE SOLUTION OF PROBLEM OF DIFFRACTION OF ELECTROMAGNETIC WAVES BY  
MULTIPLY-CONNECTED SCREENS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 9, Sep 85 (manuscript received 20 Jun 84) pp 1168-1174

MARTSAFEY, V. V. and MELNIKOVA, T. N., Odessa Electrotechnical Communications  
Institute

[Abstract] The problem of diffraction on doubly-connected curvilinear screens  
is solved on the basis of Schwarzschild's iterative method. Two two-  
dimensional problems of diffraction of a plane wave by a system consisting of  
an open cylinder and a band, in which the placement of the band with respect  
to the cylinder differ, are solved. Figures 5, references 7: 4 Russian,  
3 Western.

[103-6900/5915]

UDC 523.152

PLASMA LAYER OSCILLATION INSTABILITY DURING COMPTON SCATTERING OF POWERFUL  
ELECTROMAGNETIC RADIATION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28,  
No 8, Aug 85 (manuscript received 20 Feb 84) pp 1065-1066

LYSIKOV, Yu. I., Voroshilograd Machine Building Institute

[Abstract] The propagation of radiation flux in a plane plasma layer is  
modeled for the case of predominant induced Compton interaction between the  
radiation and the electrons and small optical thickness of the layer with  
respect to Thomson scattering. The findings indicate that it is possible for  
Langmuir oscillations to develop in the plasma layer and initiate relativistic  
effects during induced Compton interaction of the radiation flux with the  
electrons. Reference: 1 Russian.

[95-6900/5915]

UDC 551.510.535

MEASUREMENT OF SPREAD-F ECHOES FROM UPPER IONOSPHERE CAUSED BY STRONG RF  
RADIATION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28,  
No 8, Aug 83 (manuscript received 30 Mar 84) pp 972-977

BELENOV, A. F. and ZINICHEV, V. A., Scientific Research Radiophysics Institute

[Abstract] This study presents the results of an experimental investigation  
of the structure of the perturbed region obtained using an LFM ionospheric

sounding system. The actual reflection altitudes of the signal are measured with the 15 MW heating transmitter operating at close frequencies. The region of reflection altitudes is found to expand by 3-15 km after the heating system is actuated; this is found to be caused by large-scale turbulence. After the heating is turned off, the signal reflection region returns to the unperturbed level. Comparison with critical frequency data indicates that the expansion of the region of reflection altitudes is strongest when the critical frequencies exceed the heating frequency by 1.5-2 MHz. As the critical frequencies continue to approach the heating frequency, the expansion of the spectrum of the difference-frequency signal ceases to be correlated with the operating time of the heating transformer. Figures 3; references 12: 6 Russian, 6 Western.  
[95-6900/5915]

UDC 62.523.8:534.832

#### ADAPTIVE ALGORITHM FOR ACTIVE COMPENSATION OF WIDEBAND RANDOM FIELD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 8, Aug 85 (manuscript received 11 Apr 84) pp 1008-1016

ARZAMASOV, S. N. and MALTSEV, A. A., Gorkiy State University

[Abstract] The characteristics of a wideband adaptive system for active suppression of random waveguide fields based on a multidimensional transversal filter, and its operating algorithm, are investigated. An adaptive controller employing linear preemphasis filters is employed to derive second "suppressing" sources. A solution is found for the averaged algorithm equation and shown to be stable in the case of stationary original random fields. The number of channels in the adaptive controller is reduced by using tripole receivers and radiators. Block diagrams demonstrating weight coefficient adjustment are presented for wideband and narrowband active suppression systems. Figures 4, references 14: 9 Russian, 5 Western.  
[95-6900/5915]

UDC 537.874.6

#### ELECTROMAGNETIC WAVE DIFFRACTION BY PLANE WITH AZIMUTHAL CONDUCTIVITY

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 8, Aug 85 (manuscript received 4 May 84) pp 1026-1034

GOSHIN, G. G. and CHESNOKOV, A. R., Siberian Physical-Technical Institute, Tomsk University

[Abstract] Solutions are sought for the diffraction problems arising in the case of screens formed by annular conductors. A method is described for E- and H-polarization of the plane wave in which a system of integral equations of the first kind is reduced to uniform ordinary differential equations of the first kind. Expressions that contain elementary functions are derived for the components of the diffraction field, which drops off with distance as a spherical

wave. The findings are helpful for designing annular diffraction screens and assessing the influence of such screens on the characteristics of individual radiators in order to produce special radiation patterns. The method can also be employed for the diffraction field of a plane with radial conductivity.

Figures 1, references: 5 Russian.

[95-6900/5915]

BROADCASTING, CONSUMER ELECTRONICS

UDC 778.5(47+57)'1984'

REVIEW OF MAJOR WORKS ON PROFESSIONAL CINEMATOGRAPHY TECHNIQUES UNDERTAKEN  
IN 1984

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 85, pp 3-22

BONDARCHUK, V. M., IRZ, P. V., Central Design Bureau of Cinematography,  
GILINSKIY, A. G., DROZDOV, V. M., 'Ekran' Scientific-Production Association,  
Central Scientific-Technical Institute of Motion Pictures, GAYCHEVSKIY, G. Ye.,  
YEMELYANOV, G. F., ABRUKIN, Ya. A., OMELIN, V. I., USYSHKIN, Ye. I.,  
ZEMTSOVA, N. F., SHITOV, L. V., SEREGIN, A. V., GORDON, M. G., ANANYEV, V. I.  
and RAYTSIN, S. Ya.

[Abstract] This review of scientific research work performed in 1984 primarily describes new or improved cinematographic equipment manufactured in the USSR. Each device is briefly described and photographs of a number of the devices are presented. The devices include a camera with television monitor for underwater 35 mm color or monochrome cinematography, a special bus for location filming projects capable of simultaneous 35 mm film and videotape recording plus quarter inch magnetic tape audio recording with four cable inputs and two radio inputs, capable of operating on internal batteries for up to 24 hours. Also described are variable focal length lenses, a light filter set, lens parameter control device, standardized television equipment for monochrome television sights of motion picture cameras, portable lights, motion picture projectors, tape recording devices, a new series of condenser microphones, a stereophonic recording control panel, slide projectors, a semi-automatic film taping device for editing, a silver ion analyzer, a motion picture high speed copying machine and a film signal marking device.

[27-6508/5915]

UDC 534.84

STUDY OF DIFFRACTION OF SOUND WAVES ON PERIODIC STRUCTURES IN ARCHITECTURAL ACOUSTICS PROBLEMS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 85 pp 23-25

VINOGRADOVA, E. L. and PROKOFYEVA, T. N., All-Union Scientific Research Institute of Cinematography

[Abstract] The two-dimensional problem of reflection of a planar sonic wave from a surface with periodic heterogeneities is analyzed within the framework of diffraction theory. The diffraction field generated is a cylindrical diverging wave with characteristic directionality consisting of individual lobes. Even with a relatively small number of lobes, the periodic surface achieves a sufficient degree of diffuse reflection. The method suggested in this article can rapidly and effectively compute the directionality characteristics of sonic fields reflected from such periodic surfaces. It is suggested that the approach may be useful for calculation of the effectiveness of scattering structures used in large halls to control such acoustical problems as intensive echo. Figures 5, references 9: 7 Russian, 2 Western.

[27-6508/5915]

UDC 621.397.61:681.772.7

HIGH RESOLUTION CCD MATRIX CAMERA

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 85 pp 31-33

BELYAYEVA, N. N., GLYBIN, B. S., YERGANZHIYEV, N. A., IRINCHEYEV, S. M., MERKURYEV, V. V. and MOISEYEV, S. M., Leningrad Electric Engineering Institute of Communications imeni M. A. Bonch-Bruyevich

[Abstract] The resolution of TV cameras can be improved by electronic interlacing of images obtained with two or more charge-coupled device (CCD) matrices. Successive electronic interlacing of two images and alternation of two images by means of masks are possible methods of increasing image resolution. The increase in TV camera resolution using the former method is discussed. A functional diagram of a camera with two CCD matrices is presented. A major problem of such a camera is the variation in size of structural elements with changes in temperature. It is concluded that electronic interlacing of two images is the most realistic method of improving TV camera resolution at present. Figures 4, references: 4 Russian.

[27-6508/5915]

UDC 361.391.145

NONLINEAR DISTORTION IN MAGNETIC RECORDING CHANNEL

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 26 Mar 85 after revision) pp 26-28

SMIRNOV, V. A.

[Abstract] A computer method is investigated for calculating the coefficient of nonlinear distortions of the residual magnetization of the working layer of the medium and the record-playback channel in magnetic recording equipment. The perpendicular component of the field of the magnetic head reduces the nonlinear distortions of the reproduced signal, which is confirmed indirectly by experimental data. The perpendicular component of the field is found to have different effects on different characteristics of a record-playback channel with high frequency magnetization: it degrades the amplitude-wave characteristic, i.e., increases the linear distortions of the reproduced signal, but reduces the nonlinear distortions. Therefore, hardware that compensates the perpendicular component of the head field in order to improve the frequency properties of the equipment should be used only when the nonlinear distortion requirements for the recording equipment are not stringent, which must be taken into account in developing and investigating such equipment and components.

Figures 2, references 4: 3 Russian, 1 Western.

[102-6900/5915]

UDC 621.896.677

NOISE IMMUNITY OF RADIATING SYSTEM OF PERISCOPIC ANTENNA

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 24 Jan 85)  
pp 38-42

GUSEV, V. V.

[Abstract] The noise immunity of the radiating system (horn feed and electrical reflector) of a periscopic antenna is analyzed. The radiator is an asymmetrical segment of an ellipsoid of rotation; the feed is a conical horn with a discontinuous generator. Experimental and theoretical findings indicate that the noise tolerance of the radiating system is sufficient in the horizontal and oblique planes, comprising at least 51-57 dB in the sectors directed to adjacent stations. Covering the reflector increases noise tolerance to 59-64 dB and reduces short-range lateral radiation toward the tower by an average of 10 dB. Figures 8; references 5: 3 Russian, 2 Western.

[49-6900/5915]

UDC 621.396.677

DIPOLE ANTENNA ARRAY WITH LADDER-TYPE FEEDLINE

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 21 Jan 85)  
pp 42-45

TERESHIN, O. N., DVURECHENSKIY, V. D., FEDOTOV, A. Yu., YUVKO, A. N. and  
BABOVNIKOV, V. I.

[Abstract] A method is presented for designing series-driven dipole antenna arrays. The method can be used to find the design parameters of antennas for a given distribution of the current on the input terminals of the dipoles for which good efficiency and appropriate radiation pattern characteristics are achieved in the antenna. The method is checked against a traveling-wave dipole, measuring the input impedances of the dipoles along the antenna calculated by the induced emf method considering mirror reflection. The experimental findings confirm the theoretical results, and indicate that the proposed method can be employed for engineering purposes. Figures 5; references:

3 Russian.

[49-6900/5915]

CIRCUITS AND SYSTEMS

UDC 621.396.662.2(088.8)

MAGNETOELECTRONIC RESONANCE SYSTEMS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received after revision 1 Dec 83) pp 88-92

KHAMITOV, V. G., candidate of technical sciences, assistant professor,  
Ufimskiy Aviation Institute; and KHAMITOV, M. Ya., graduate student, Ufimskiy  
Aviation Institute

[Abstract] During the creation of low-frequency selective devices, generators  
of a sinusoidal signal with LC-circuits, difficulties arise in obtaining a  
high-Q inductance coil with overall dimensions and mass acceptable from a  
practical standpoint. This is because the resistance of the conductor at low  
frequencies becomes commensurate with the inductance of the inductance coil.  
In addition, the ferromagnetic core commonly used for an increase of the  
magnitude of the inductance introduces considerable losses into the circuit.  
In this paper, use of negative resistance converters is considered in order to  
increase the Q-factor and reduce the mass-dimension indices of the LC-circuits.  
The results of a theoretical analysis of proposed magneto-electric circuits  
are presented as well as the results of experimental investigations.

Figures 3; references: 4 Russian.  
[109-6415/5915]

UDC 621.373.12:519.6

STOCHASTIC OSCILLATIONS IN SYSTEM OF COUPLED OSCILLATORS WITH INERTIA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 17 Jul 84) pp 1570-1576

KALYANOV, E. V. and LEBEDEV, M. N.

[Abstract] The performance of two capacitively coupled oscillators with  
inertia and strong nonlinearity is analyzed, on the basis of a mathematical  
model which in the absence of inertia and coupling degenerates into a one-  
dimensional Van der Pol equation for a single oscillator. Numerical solution  
of this system of nondimensionalized equations by the fourth-order Runge-Kutta  
method reveals that, while each oscillator operating separately generates non-  
sinusoidal oscillations, "competition" of interacting oscillations of both

oscillators during their simultaneous operation generates stochastic oscillations: random push-pull oscillations at frequencies close to the partial-oscillation frequencies of both. An experimental confirmation was obtained by testing two and three coupled oscillators on a KT-911A transistor each, also testing a single such oscillator for reference, as well as arrays of coupled oscillators on K 532GG1P integrated-microcircuit chips. Figures 5; references: 7 Russian.

[66-2415/5915]

UDC 681.518.22

#### SYNTHESIS OF TWO-CHANNEL ELECTROMECHANICAL TRACKING SYSTEMS WITH RANDOM INFLUENCES CONSIDERING LIMITATIONS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 6, Jun 85 (manuscript received after revision 3 Oct 84) pp 55-59

KUZNETSOV, B. I.

[Abstract] Multichannel systems with an iterative control algorithm are used to increase the accuracy of measurement of the coordinates of rapidly moving objects. Increased accuracy is achieved in such systems by implementing the method of successive approximations through multiple channels, the second channel compensating for errors of the first, coarse channel. This article studies the synthesis of parameters of such a two-channel system by assuming random useful signal and noise at the inputs. The synthesis of the transmission bands of the channels of the electromechanical tracking system is based on the criterion of minimum tracking error dispersion considering limitations of maximum acceleration and speed of the actuating motors. The theoretical calculations were confirmed by practical tests. Figures 3; references: 8 Russian.

[25-6508/5915]

UDC 621.396.6

#### LOW-LOSS SAW BANDPASS FILTER

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85 (manuscript received 4 Mar 85)  
pp 43-44

BULYUK, A. I.

[Abstract] Filters based on one-directional sectioned transducers and converters with capacitively weighted electrodes are described and investigated. In contrast to ordinary bidirectional devices employing interleaved transducers, the proposed design makes it possible to process signals with low losses. Two filters are described: One based on a transducer with capacitively coupled electrodes and a one-directional transducer made up of two one-directional sections, and the other consisting of three transducers: One with

capacitively coupled electrodes in the middle, and one with identical one-directional transducers on either side. The latter type is found to exhibit induced losses of approximately 3.0 dB, with irregularity of the amplitude-frequency characteristic not exceeding 0.4 dB within the passband, and side lobe level not exceeding 30 dB. The results demonstrate the possibility of realizing a broad class of filters with low induced losses that can be fabricated using ordinary technology employing single-pass photolithography.

Figures 2, references 9: 2 Russian, 7 Western.

[102-6900/5915]

UDC 621.372.54.037.372

#### PYRAMIDAL STRUCTURE FOR DIGITAL BANDPASS FILTERS WITH INFINITE MEMORY

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received after revision 3 Feb 85) pp 45-49

VITYAZEV, V. V. and MURAVYEV, S. I.

[Abstract] A method proposed previously by the author for designing digital bandpass filters employing two-stage and multistage structures is extended to the case of a family of digital bandpass filters with infinite memory. A pyramidal filter structure is proposed based on cascading low-sensitivity, low-noise comb filters with infinite memory. The base of the structure is made up of R elementary digital filters (generally, Butterworth filters of order no higher than 3); the apex, which is the input of the system, consists of a two-channel digital comb filter that splits the input signal spectrum into a set of R/2 even and R/2 odd components, and unidimensionally converts the latter to the frequency region occupied by the set of even components. The proposed pyramidal filter structure is found to be significantly more effective than an uncascaded design; it reduces the sensitivity of the poles to change in the coefficients of the filters while providing a slight gain in terms of the overall amount of computation, as well as an increase in the number of memory resistors that is acceptable for practical purposes. Figures 3; references 6: 4 Russian, 2 Western.

[102-6900/5915]

## COMMUNICATIONS

UDC 656.254.16:621.396.931

### TRANSPORT-SRS RADIO NETWORKS FOR STATION RADIO COMMUNICATION

Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 9, Sep 85 pp 11-14

VAVANOV, Yu. V., candidate of technical sciences, department head, All-Union Scientific Research Institute of Railroad Transportation, ZYKOV, V. I., candidate of technical sciences, and RAGOZINA, L. V., chief engineer

[Abstract] Three types of radio transmitters are used for communication during train shunting and crossing maneuvers in railroad junction yards: RV-3 portable units on locomotives, RS-23 stationary units in control rooms, and RN-12 portable units carried together with PRM-N radio receivers by the field crew. Their ranges are in accordance with Station Radio Communication requirements, namely: RS-RV up to 7 km, RS-RN up to 3 km, RV-RN up to 2 km, RN-RN up to 1.5 km. The entire network is designed and laid out for complete coverage of the entire maneuvering operation under the dispatcher's control, all communications being tape recorded. An outstanding feature of such a network is the possibility of conference calls initiated by the dispatcher (audio frequency 1000 Hz) and selective calls from an engineer (audio frequency 1400 Hz) as well as two-way calls among the yard crew (audio frequency 2100 Hz). Figures 6. [85-2415/5915]

### COMPLETE AUTOMATION FOR UNDERGROUND TRUNK LINES

Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 9, Sep 85 pp 1-2

ZHUKOV, A. I., chief, Department of Automation, Signalization and Communication, Main Administration of Metropolitan Subway Systems, USSR Ministry of Railroads

[Abstract] Metropolitan subway systems are now operating in Moscow, Leningrad, Minsk, Kiev, Kharkov, Tbilisi, Yerevan, Baku, Tashkent and also will be in Gorkiy and Novosibirsk by the end of 1985. Their combined two-way track length is 459 km and they have together 300 stations. A major problem is replacing the present 30-40 years old electromechanical automatic controls in stations with electronic automatic locomotive signalization and speed regulation. These controls include interlocking for both reliable and safe movement of trains. Developed jointly by the All-Union Scientific Research Institute of Railroad Transportation and the Moscow Institute of Railroad Transportation Engineers with a few other organizations, already installed on almost half

of all Moscow and Leningrad subway lines, they have replaced a labor force of 1200 locomotive personnel with a cost saving of 1.5 million rubles in the tenth Five-Year-Plan period and are expected to do as well in this and the next Five-Year-Plan periods. Altogether 21 modes of service communication are now in use, audio communication from dispatcher to engineer being one of the principal ones. Introduction of computer and television technologies, with reliable and safe complete automation of train movement controls is expected to contribute to the national economy a saving of 29 million rubles in the twelfth Five-Year-Plan period. Development of installation of a second-generation Metro Automatic Control System with necessary monitoring and reliability assurance is planned for that 1986-1990 period.

[85-2415/5915]

UDC 656.259.2:621.317

#### INSTRUMENT FOR MEASURING TIME PARAMETERS OF AUTOMATIC-LOCOMOTIVE-SIGNALIZATION CODES

Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 9, Sep 85 pp 29-33

KUSTOV, G. M., candidate of technical sciences, assistant professor, Kharkov Institute of Railroad Transportation Engineers, OSPISHCHEV, N. V., senior engineer and GORDIYENKO, Yu. V., senior engineer, Automation, Telemechanics and Communication Laboratory, Southern Railroad Line

[Abstract] An instrument has been developed for measuring the time parameters of automatic-locomotive-signalization codes under any voltage within the 2-200 V range, outdoors at any point of the communication channel along the track. It measures the duration of the first pulse or of the first interval as well as the duration of the code cycle, which is sufficient for determining the characteristics such as distortion of all other code elements generated by an electromechanical device. The instrument can be set for a time limit of 1 s or 10 s. The error of measurement across clear contactors and across busy contactors is  $\pm 2$  ms and  $\pm 10$  ms respectively. The instrument consists of an input pulse-to-level converter which includes an amplifier with automatic gain control and a comparator, a shaper of square pulses of duration corresponding to the input code, with protective filters against pulse interference and contact jitter, a duration discriminator, a 3-digit counter with digital indicator, a 1 kHz/10 kHz oscillator, and a synchronizer. The cycle duration is measured by a trigger, a coincidence circuit, an inverter and an OR gate. The instrument hardware includes 49 resistors, 13 capacitors, 6 diodes, 4 stabilistrons, 1 light-emitting diode, 29 transistors, 1 rectifier, 1 transformer, 18 series K176 microcircuits and 2 series K553 microcircuits--all assembled on four printed-circuit boards inside a case made of a dielectric material. Ten such instruments were built and have been successfully used on four track sections with different automatic blocking systems and traction modes. Figures 7; tables 1.

[85-2415/5915]

UDC 621.3.015.51:550.3

INFLUENCE OF TWO-LAYER SOIL ON DENSITY OF LIGHTNING DAMAGE TO  
COMMUNICATIONS CABLES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 10,  
Oct 85 pp 48-51

ZEMTSOV, V. A., engineer, Institute of Geology, Karelian Branch,  
USSR Academy of Sciences

[Abstract] A method is proposed for accounting for the density of lightning damage to buried cable lines. In contrast to earlier methods, the proposed method employs a model of a two-layer geoelectric medium with a horizontal interface boundary, making it possible to take into account the geological and geoelectric characteristics of soils and irregularity of their relative electrical resistances. Experiments are described that indicate the possibility of employing the proposed method to calculate the number of lightning damage sites on a cable. The results are found to agree with the number of recorded instances of lightning damaged to buried cables. The method can also be used in designing new lines to identify the most susceptible areas and to select the proper type of cable to employ.

[113-6900/5915]

UDC 621.375.4.029.64:621.382.3

RECEIVER FOR GROUND STATIONS OF SATELLITE COMMUNICATION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after completion 21 Dec 84) pp 25-28

ANGELOV, I., STOYEV, I., SPASOV, A., URSHEV, L. and KOKONCHEV, L.,  
Bulgarian People's Republic

[Abstract] A receiver has been designed and built for ground stations of satellite communication systems operating in the 11.5-12 GHz frequency band. It consists of a 2-stage microwave amplifier, a balancing mixer, and intermediate-frequency amplifier, and a temperature stabilization system for the transistors. The microwave amplifier, with an HFET2201 (AP326A) Schottky-barrier field-effect transistor in each stage, was designed on the basis of an equivalent circuit with lumped input and output parameters. The balancing mixer is a hybrid 3 dB bridge which divides the signal and heterodyne power equally between two diodes, a 180° bridge being preferable to a 90° one at frequencies above 10 GHz. Both the microwave amplifier and the balancing bridge are built in the form of microstrip lines on teflon substrate 0.5 mm thick with glass reinforcement. The i-f amplifier has a common-emitter stage and a common-collector stage to ensure a gain of 14+1 dB with a sufficiently low output impedance of 50 ohms and a sufficiently high input impedance of 150-200 ohms in the 30-100 MHz frequency range, which requires the use of

high-quality RFR93 transistors. The i-f amplifier and the temperature-stabilizing hybrid integrated microcircuits are built as thin-film devices, which allows placing this amplifier next to the mixer with minimum stray capacitance and leakage inductance. Figures 5; tables 1; references: 3 Western.  
[80-2415/5915]

UDC 621.391.83.088

CORRECTION OF DISTORTIONS IN HYBRID CHANNELS OF RURAL DIGITAL DATA TRANSMISSION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 21 Dec 84) pp 37-39

KIKVADZE, L. V. and LEV, A. Yu.

[Abstract] A harmonic adaptive corrector is considered for compensation of random distortions in hybrid channels of digital data transmission systems resulting from such causes as variance of cable characteristics, aging of equipment, and regulation errors. Such distortions produce not only intersymbol distortions in the digital channels but also additive interference at the resolver input, while such a corrector allows independent regulation of amplitude-frequency and phase-frequency characteristics. Aperture of the eye chart serves as fidelity criterion, defined as  $\phi = \frac{\min}{j=1,m} (y_j^{(1)} - \xi_j^{(1)}) - \frac{\max}{j=1,m} (y_j^{(0)} - \xi_j^{(0)})$  ( $y_j^{(1)}, y_j^{(0)}$  - readings of corrector output signal during reception of pulse ("1") or blank ("0") without additive interference,  $\xi_j^{(1)}$  - readings of additive interference,  $m$  - number of readings in processing cycle,  $\min$  and  $\max$  referring to averages over realizations). For a sufficiently large  $m$  this aperture indicator is also  $\phi = \phi_{isi} - \phi_{ai}$  ( $isi$  - intersymbol distortions,  $ai$  - additive interference). Calculation of both  $\phi_{isi}$  and  $\phi_{ai}$  yields an expression for  $\phi(\alpha)$  describing a surface in a multidimensional space with  $\alpha$  coordinate axes. This  $\phi$ -surface is, by a rigorous proof, shown to be a convex one. Consequently, the corrector can be tuned by iterations according to the "aperture of eye chart" criterion. Inasmuch as tuning time is not a significant factor in hybrid line channels, moreover, the correction algorithm can be selected on the basis of simplicity alone. References 5: 3 Russian, 2 Western.  
[80-2415/5915]

AUTOMATIC MEASUREMENT OF NONUNIFORMITY OF AMPLITUDE-FREQUENCY  
CHARACTERISTICS AND OF GROUP TIME DELAY ON BASIS OF DISCRETE FOURIER  
TRANSFORMATION

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after abridgment 29 Oct 84) pp 73-75

BYCHKOV, S. O. and LAVRENTYEV, A. I.

[Abstract] Use of the discrete Fourier transformation with the fast-Fourier-transformation algorithm is considered for determining the frequency characteristics of wideband communication systems. This includes determining the parameters of test signals, depending on the required resolution during measurements of the group delay time and the amplitude-frequency characteristic. The feasibility of this method is demonstrated with an apparatus which consists of a clock-pulse generator, a memory, a test-signal synthesizer, and a low-pass filter in the transmitter part, a clock-pulse generator, an analog-to-digital converter, a memory, a discrete Fourier transformer, and a computer in the receiver part, with the analyzed system between the low-pass filter of the transmitter and the analog-to-digital converter of the receiver, and with the transmitter memory as well as the discrete Fourier transformer feeding data into the computer. A factor which limits generation and transmission of a test signal with the required waveform, especially for a high-frequency telephone channel, is the frequency instability of the two clock-pulse generators. Their instability can be minimized by locking the two generators so that the shift of harmonic frequencies becomes negligible, with the resolution of measurements becoming practically unlimited and only the computer capability limiting the pulse repetition period of the two clock generators. Use of the discrete Fourier transformation can thus contribute to more extensive automation of such measurements, despite the relatively low immunity of this method to stray pickups and interference. Figures 1; references 3:

1 Russian, 2 Western.

[80-2415/5915]

MULTICHANNEL TELEMETERING WITH INCREASED METROLOGICAL RELIABILITY

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 14 Dec 84) pp 3-7

ZHURAVIN, L. G., PERZNER, A. G., and SEMENOV, Ye. I., Leningrad Electrical  
Engineering Institute imeni V. I. Ulyanov (Lenin)

[Abstract] This paper continues one by the same authors: "Increase of Noise  
Immunity and Metrological Reliability of a Telemetering System with Group  
Measuring Representation," submitted on 10 May 83 to TsNIITEI Priborostroyeniye  
(Central Scientific Research Institute of Instrumentation). Here algorithms

are analyzed of multichannel telemeters resistant to failures or malfunctions of a part of the communication channels, which are based on use of coding numerical matrices with a surplus number of rows. The effectiveness is shown of a matrix of dimensions  $2 \times 2$  which consists of a unit matrix and a normalized Adamar matrix. The paper was recommended by the Department of Data Processing and Measurement Technology. References: 3 Russian.  
[90-6415/5915]

UDC 621.396.96

#### PROPERTIES OF SIGNALS WITH TRIANGULAR PHASE CHANGE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received after revision 5 Mar 85) pp 12-17

TERYAYEV, B. G.

[Abstract] The basic properties of signals with small out-of-band radiation and exhibiting a continuous discrete spectrum with discrete lines located at frequencies  $\pm(1/2t_0)2\pi k$ , where  $k=0, 1, 2, \dots$  are examined. The reference oscillation and timing pulses are extracted by narrowband filtering of the discrete lines. Near-ideal detection conditions are provided with bandwidths of the filtering elements in the synchronization devices 20-30 times narrower than the bandwidth of the receiver IF amplifier; the demodulator synchronization time is only a few tens of signal elements long. Because the reference oscillation in demodulators for signals with triangular phase change exhibits no initial phase indeterminacy, there is no need to use differential coding in the modulator or decoding in the receiver, in contrast to modems for PSK signals. The theoretical findings are confirmed experimentally. Figures 4, references 13: 11 Russian, 2 Western.  
[102-6900/5915]

UDC 621.266

#### DETECTION OF SPONTANEOUSLY OCCURRING MARKOV SIGNAL

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 5 Mar 85 after revision), pp 18-21

OSIPOV, A. N.

[Abstract] The detection of a spontaneously occurring Markov signal with arbitrary duration is examined for the case of discrete time. A detection algorithm is derived, and sufficient statistics are identified using a Bayesian information processing procedure. Suboptimal algorithms based on reducing the sufficient statistic space are analyzed. A modified version of degenerate sequential analysis is shown to degrade system performance only when the detection thresholds are relatively low. Figures 1, references: 7 Russian.  
[102-6900/5915]

UDC 621.37:62-192

USE OF STRUCTURAL REDUNDANCY TO IMPROVE RELIABILITY OF RADIO SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 8 Apr 85 after revision) pp 28-32

VULMAN, I. D.

[Abstract] The effectiveness of scheduled recovery testing of each of the subsystems in a structurally redundant system is investigated. It is found that scheduled recovery testing of each of the redundant subsystems in radio equipment at a frequency much smaller than the mean time between failures of the system makes it possible to increase the MTBF significantly.

References: 3 Russian

[102-6900/5915]

UDC 621.391.26

MATRIX NOTATION FOR GENERALIZED FAST FOURIER TRANSFORM ALGORITHMS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85  
(manuscript received 24 Mar 85 after revision) pp 55-60

SVERDLIK, M. B. and TIKODRI-TOGBOA, S. S.

[Abstract] Generalized matrix notations are derived for FFT algorithms that do not require the use of transposition matrices and make it possible to obtain FFT algorithms with the minimum possible number of multiplications if N can be expanded into mutually prime factors or can be represented in canonical form, and make it possible to avoid the property of mutual inversion of the numbering of the input and output samples. In contrast to Good's algorithm, the algorithms derived do not require the use of the Chinese theorem of residues. The existing matrix notations for FFT algorithms are shown to flow as special cases from the proposed notations. Figures 1, references 10: 7 Russian, 3 Western.

[102-6900/5915]

UDC 537.86/87

RANDOMIZATION OF SELF-SUSTAINED OSCILLATIONS BY INTRINSIC SYSTEM NOISE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 9, Sep 85 (manuscript received 2 Dec 84) pp 1126-1135

YEZERSKIY, A. B., KIYASHKO, S. V. and REYTOV, V. P., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] The connection between anomalously strong noise randomization of periodic self-sustained oscillations and the properties of the system in a

phase space is examined. The occurrence of randomness in a tuned input/tuned output RF oscillator, which exhibits simple behavior in the absence of noise, is considered as an example. Random oscillations in this oscillator are investigated experimentally. It is found that the periodic mode, which exhibits large stability reserves in the integral sense, can be strongly randomized by intrinsic system noise if there are unstable sections in the orbitally stable limiting cycle, corresponding to that mode. Strong local instability of periodic motion is associated with the occurrence of a large parameter in the system, which makes the ratio of the increment of the deviations to the period of the self-sustained oscillations large. When the local instability exhibits nonlinear saturation, the nature of the random oscillation may change qualitatively. Figures 7, references: 10 Russian.  
[103-6900/5915]

UDC 621.395

#### RURAL TELEPHONE NETWORK LOADING

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85  
(manuscript received 16 Mar 82) pp 9-13

KORNYSHOV, Yu. N., CHUMAK, N. A. and DUZ, V. I.

[Abstract] The results of measurements of rural telephone traffic load parameters in the Ukrainian, Moldavian, Belorussian, Lithuanian SSRs and the European part of the RSFSR are analyzed. The distribution of calls by types of traffic in rural networks is analyzed. Data on rural network subscriber loading, interoffice loading, long distance loading, and traffic destined for special services at regional centers are analyzed. Two basic trends in subscriber loading are observed: The expansion of rural networks and the increased capacity of automatic exchanges are resulting in a gradual increase in the relative traffic loading from subscribers of all categories; the second trend results from change in the structural composition of the subscribers as the network expands. The findings provide an idea of the magnitude of the various load parameters and the general ways in which they change, and can be used in designing rural telephone networks when no measured initial data are available. Figures 3, references: 6 Russian.

[49-6900/5915]

UDC 621.391.1:519.211

MESSAGE DELIVERY TIME IN CHANNEL-SWITCHING SYSTEM

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 25 Jul 84)  
pp 13-16

NETES, V. A. and SHVARTSMAN, V. O.

[Abstract] Message delivery time in channel-switching information distribution systems is determined for the case in which each subscriber has memory to store all untransmitted messages. The analysis employs a model that is characteristic for many digital transmission systems in which the subscriber has access to a channel switching network via a subscriber loop and in which reception and transmission are separate and can therefore be simultaneous. The subscriber terminal device employs an accumulator; if the line is being used to transmit messages already received when a message comes in, the latter is placed in the accumulator where it is queued for transmission. Expressions are derived for the basic parameters of channel switching systems as queuing systems that can be used in system design to ensure the required average message delivery time, and to establish standards for subscriber line traffic loading and denied-service probability. References: 3 Western.

[49-6900/5915]

UDC 621.391.833.019.3

LINEAR TRANSFORMATION METHOD FOR COMPARING CABLE CIRCUITS IN DIGITAL TRANSMISSION SYSTEMS IN TERMS OF THERMAL NOISE

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 16 May 84)  
pp 17-23

SHTEJN, V. M. and SHUVALOV, V. A.

[Abstract] This study extends a method developed previously by the authors for comparing digital transmission circuits whose differences can be reduced to certain equivalent linear transformations. By restricting the conditions under which the earlier findings are applicable for certain circuit characteristics, pulse shapes, codes, etc., the modified method makes possible a more comprehensive comparison of circuits. A model is derived for comparing two regeneration sections that differ in the shape of the line input pulses, or in the shape of the pulses and the point at which the code conversion is performed. Noise levels are analyzed for pulses with different shapes and fixed signal peak-to-peak value, for non-symmetrical pulses with different polarity, for transmission with partial response and fixed signal peak-to-peak value, for pulses with different shapes and fixed average signal power, and for partial response and fixed average signal power. Figures 4, references 7: 4 Russian, 3 Western.

[49-6900/5915]

UDC 621.315.23

CEMA STANDARDS FOR BALANCED HF COMMUNICATIONS CABLES

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 pp 27-29

LAKERNIK, R. M.

[Abstract] CEMA Standard 4451-83 "Cables, RF balance, polystyrene insulators", which goes into force 1 January 86 and replaces previous CEMA recommendations RS81-67 and RS225-69, is described. The purpose of the new CEMA standard is to unify the design and technical parameters of cables produced in different countries, to improve their performance, and to expand their interchangeability to make it possible to increase the exchange of goods among the CEMA member countries. 17 types of polystyrene-insulated cables are established; these types and their areas of application are presented in table form. The rated sheathing thickness, jacket thickness, and fixed test voltage levels for armored and unarmored cables are presented. Inasmuch as implementation of the CEMA standard will save polystyrene and will require no modifications by cable producers or users, the standard was implemented early in the USSR, on 1 January 1985.

[49-6900/5915]

UDC 621.356.975.5

PRINCIPLES OF DESIGN AND ANALYSIS OF MUNICIPAL WIRED-RADIO BROADCAST CABLES

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 24 Sep 84)  
pp 30-34

KORIN, I. L.

[Abstract] The design of buried cable lines for wired-radio broadcast now used to replace overhead lines is described. The structure of the cable distribution feeder, which incorporates a distribution line, subscriber transformers, and subscriber installations, is explained. The attenuation in the inside house network is analyzed for different numbers of connected sections, and the number of sections that can be connected is analyzed as a function of the number of floors in the building. The use of cable for wired-radio broadcasting is found to be effective in new municipal construction; the construction of cable lines for wired-radio broadcasting is difficult because of the lack of available space in existing conduits. Figures 4; references: 5 Russian.

[49-6900/5915]

CALCULATION OF ACCEPTABLE DEVIATIONS OF WAVE IMPEDANCES OF LONG LINES IN  
BROADBAND TRANSFORMERS

Moscow ELEKTROSVYAZ in Russian No 8, Aug 85 (manuscript received 12 Dec 84)  
pp 45-48

LONDON, S. E., SINEPOL, V. S. and TOMACHEVICH, S. V.

[Abstract] This study addresses the calculation of acceptable deviations of the wave impedances of the long lines that form the windings of broadband transformers employed at frequencies ranging from VLF to VHF. The widest range of working frequencies is provided by transformers employing two-step multi-conductor lines; however, these require that the wave impedances of the line stages be extremely precise, making it necessary to determine the acceptable wave impedance deviations. The behavior of the transformation characteristics as the wave impedances deviate from their nominal values is analyzed. Curves are plotted on the basis of statistical analysis that can be used to find the tolerances for the deviations of the wave impedances for which transformers employing two-stage lines provide the required coefficient of reflection in the required frequency band. It is found analytically that transformers employing two-stage lines provide a working band 1.5-2 times larger than transformers employing matched two-conductor lines. Figures 4; references 3: 2 Russian, 1 Western.

[49-6900/5915]

COMPONENTS, HYBRIDS AND MANUFACTURING TECHNOLOGY

UDC 531.787.084.2:621.382

PRODUCTION TECHNOLOGY FOR RESISTANCE STRAIN-GAUGE TRANSDUCERS BASED ON HETEROEPITAXIAL SILICON-ON-SAPPHIRE STRUCTURES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 17-19

MIKHAYLOV, I. T., candidate of engineering sciences and PEREPELITSYN, O. P., engineer

[Abstract] The technology used to manufacture silicon-on-sapphire integrated strain gauge transducers is described using the D-16 and D-100 single-membrane strain gauges employed in Sapfir-22 transducers as an example. The processes entailed in fabricating the miniature mechanical sensing element are described. The use of silicon-on-sapphire structures with optimal doping levels makes it possible to achieve minimum temperature errors; however, it has not been possible to obtain heteroepitaxial silicon with the required tolerances. Improvements are suggested to make it possible to satisfy the industrial demands for strain gauges and to facilitate stable growth in the volume of production while keeping costs down. Figures 3; references: 11 Russian.  
[94-6900/5915]

UDC 681.325.5-181.4:658.562.6

INPUT TESTING OF LSI MICROPROCESSORS ON AMTS 0560 TESTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 28-29

VOGORODITSKIY, A. A., candidate of technical sciences, DOBROVINSKAYA, D. D., KIRILYUK, Ye. L., PUNKEVICH, V. S. and RUTSHTEYN, L. M., engineers

[Abstract] The software employed in the AMTS 0560 automated functional tester, which is designed for input testing of series KR580 and K589 LSI microprocessor complexes, is examined. The standard software incorporates individual components of the Elektronika-60 computer software; special programs are implemented in ASSEMBLER language. Two groups of programs are described: preventive maintenance and testing programs, and LSI function testing programs. It is recommended that the user test LSI microprocessors for conformance with technical specifications and with respect to special programs that closely approximate the specific operating conditions of the devices in the intended equipment, inasmuch as the technical characteristics and microprogram control method used by the AMTS 0560 tester make it possible to develop functional testing programs that incorporate several tens of thousands of test sequences, and to test LSI circuits under actual operating conditions. Figures 2.  
[94-6900/5915]

UDC 681.32.9.08:621.9.049

QUICK SOFTWARE TESTING OF PRINTED WIRING AND BUNDLED CONNECTIONS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 29-30

KRASNOVA, N. P., MALCHUSHKIN, V. A., MERKULOV, V. A. and SHAROPALOVA, N. P., engineers

[Abstract] An automated system for testing bundled connections and printed wiring is described. The system is based on an Elektronika-60 computer; wiring is tested according to a design address table and a conditional address circuit table. An automatic mask fabrication testing procedure is described. The proposed software method for testing bundled connections and printed wiring identifies wiring errors accurately and quickly. A 235x140 mm PC board with more than 200 circuits was tested in less than 10 seconds, not counting the time to print out the errors. A wiring block with about 3000 contacts was tested in two-three minutes.

[94-6900/5915]

UDC 681.326.74.06

PNZU-26 MEMORY ADJUSTMENT CONSOLE

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 p 32

SMALIY, O. P. and MYLNIKOVA, N. A., engineers

[Abstract] The PNZU-26 memory device adjustment console, which is used for adjusting and testing SM computer and ASVT-PS random access memory devices and units, is described. The system can be employed at manufacturing plants and computer maintenance centers. The device provides a maximum testing frequency of 5 MHz for a 1024 Kword RAM device. Twenty address outputs, 36 data outputs, and 36 data inputs are provided. The types of tests and selectable operating modes are described.

[94-6900/5915]

COMPUTERS

UDC 621.391:519.725

RAPID DECODING OF FIRST-ORDER REED-MULLER CODES IN A CHANNEL WITH ERASURE

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 1 Jun 83) pp 27-31

LITSYN, S. N. and SHEKHOVTSOV, O. I., Leningrad Electrical Engineering  
Institute imeni V. I. Ulyanov (Lenin)

[Abstract] The paper describes an algorithm for decoding first-order Reed-Muller codes in channels with an erasure having a complexity which is linear with respect to the length of the code (and, consequently, also for code distance). The comparative graphic dependences are shown in a figure for the calculating expenditures of: 1) Algorithms on a basis of the Gauss method; 2) Algorithms on a basis of the Walsh fast transformation; and 3) New algorithm with condition of equal complexities of operations of composition and comparison. The relations between the basic operations of composition and comparison and the auxiliary routines in the assembler language program of the Elektronika-60 microcomputer are presented in a table. The paper was recommended by the Department of Automated Systems of Information Processing and Control.

Figures 1; tables 1; references: 3 Russian.

[90-6415/5915]

UDC 681.325

HYPERBOLIC FUNCTIONS CALCULATOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 26 Oct 84) pp 31-35

BAYKOV, V. D. and KRYS, A. I., Mariyskiy Polytechnical Institute imeni  
A. M. Gorkiy

[Abstract] The construction of fast-response computers of elementary functions, including hyperbolic, is a problem of current interest to engineers developing high-performance electronic computers. A promising universal base for integrated computers, realizing a specific group of functions, is non-commutated logical matrices which make it possible sharply to reduce expenditures on the development and production of large-scale integrated circuits (LSI). The paper considers realization of a specialized LSI for computation of

hyperbolic  $\tanh^{-1}$  and  $\sinh^{-1}$ . A modified iterational method of "digit after digit" with sign-changing--constant sign increments is the basis of the design. The paper is recommended by the Department of Construction and Production of Radio Equipment. Figures 4; tables 1; references: 5 Russian.  
[90-6415/5915]

UDC 681.327.8:658.012.011.56

#### RESULTS OF FUNCTIONAL TESTING OF TELE YeS SYSTEM

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 9-10

KUZMIN, V. N. and KAZAK, A. S., candidates of technical sciences

[Abstract] Functional testing of the expanded TELE YeS network teleprocessing system is described. The tests were conducted in order to determine whether the system can operate under actual conditions over switched and assigned channels with various hardware and software configurations. The tested configuration incorporated computer complex, data teleprocessors, communications channels, group terminal controllers, and terminal stations. The computer complex in the TELE YeS system is based on two computers operating in tandem (YeS-1055 and YeS-1055M) with virtual RAM and combined speed of 900,000 operations per second. The operability of the teleprocessing system was checked by implementing functional working system chains sequentially: 20 basic chains connected locally or remotely to the computer complex were tested. The functional tests of the hardware and software making up the TELE YeS system confirm that the facilities can operate in the configurations investigated. This allows the TELE YeS system to be used to build high efficiency distributed data processing systems in computer networks and automated management systems.

Figures 3, table 1.

[94-6900/5915]

UDC 681.327.634.539.216

#### MAGNETIC DISCS WITH THIN-FILM METAL COATINGS (REVIEW)

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 34-36

GELEZHUNAS, V. A., candidate of technical sciences, ANDRIATIS, A. K. and FAKTOROVICH, A. A., engineers and VASILEVA, N. P., doctor of technical sciences

[Abstract] A review is presented of metal-coated magnetic fixed discs. The requirements for the base, intermediate, magnetic, and protective layers are examined. Trends towards increased recording density and decreased head clearance are described. The properties of the base employed for fixed discs are discussed. The application of magnetic coatings and the use of lubricating materials are discussed. Tables 1, references 19: 5 Russian, 14 Western.  
[94-6900/5915]

ELECTRON DEVICES

UDC (621.311.6:621.791.927.55).001.1

POWER SOURCES WITH METERED ENERGY TRANSMISSION FOR ION-PLASMA COATING  
INSTALLATIONS

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 6 Dec 84) pp 5-7

AYZENSHTEYN, A. G. and BULATOV, O. G., candidates of technical sciences,  
VORONIN, A. A. and KIRICHENKO, V. V., engineers and TSARENKO, A. I.,  
candidate of technical sciences

[Abstract] Power supplies for ion-plasma coating installations are examined that employ a thyristor regulator scheme with metered transmission of energy. Expressions are derived for the characteristics of the accelerating voltage source employed. The characteristics are found to be similar to those of a variable voltage source over a fairly wide range of load variation. The accelerating voltage source makes it possible to stabilize the surface temperature of the parts being treated while the coating is being applied by applying short pulses of higher voltage to the articles periodically. The IT-20/1500 thyristor convertor built by Uralelektryazhmarsh is described that provides good dynamic characteristics of the power source to insure stable combustion of the vacuum arc discharge in the system evaporator. Figures 7;  
references: 4 Russian.  
[110-6900/5915]

UDC 621.791.762:621.314.241

THYRISTOR CONVERTER FOR HIGH-POWER ELECTRIC CONTACT WELDING INSTALLATIONS

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85 (manuscript received 9 Aug 84)  
pp 7-10

BULATOV, O. G., candidate of technical sciences, POLYAKOV, V. D., engineer,  
and TSARENKO, A. I., candidate of technical sciences, Moscow Electrotechnical  
Institute

[Abstract] The use of a static converter to change three-phase voltage to variable single-phase voltage with intermediate dc storage (capacitive or storage battery) for powering electrocontact welding rigs is described. Simulation studies are described in which the dynamic operating modes of the

converter were studied. Experimentation with the proposed converter in a welding rig confirmed that the circuit parameters were selected properly; the converter permitted stable operation in all technological modes. In addition to increasing the power of the rig, the throughput capacity was increased by reducing welding time by 10-15 percent; a 20 percent reduction in metal consumption was also achieved. Figures 5; references 3: 2 Russian, 1 Western.  
[110-6900/5915]

UDC 621.311.62:621.375.826

#### VARIABLE POWER SUPPLY FOR ION LASER

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85 (manuscript received 24 Oct 84)  
pp 10-12

GORBACHEV, M. N., engineer and ZAKREVSKIY, S. I., candidate of technical sciences, Institute of Electrodynamics, Ukrainian SSR Academy of Sciences

[Abstract] A variable ion laser power supply is described that employs a circuit combining a continuously variable current source and a discretely variable voltage source, providing a maximum output of 12.5 kW. The current channel and voltage channel are connected in series and work into a common load. The device provides a wide range of output power adjustment and good stability of the load current throughout the entire continuous adjustment band. The output circuits are galvanically decoupled from the line and natural cooling is employed for all of the power elements in the circuit. Experimental operation of the device with various types of ion lasers confirmed its reliability and superior adjustment and power indicators. Figures 3; references: 5 Russian.  
[110-6900/5915]

UDC 621.389.001.2

#### ANTINOISE COMPENSATION IN OPTOELECTRONIC DEVICES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 21 Jan 85) pp 1-3

SMOLYANSKIY, B. Ye.

[Abstract] The characteristics of noise compensation are investigated for basic classes of receiving systems employed in optoelectronic devices, such as pulse optical range meters and devices employing harmonic signal modulation such as radiometers. It is found that the thermal noise of the load resistor of the photosensor can be suppressed to any degree through noise compensation regardless of the bandwidth of the circuit and the internal impedance of the signal source. A compensation filter becomes unnecessary if the internal impedance of the photodetector is smaller than the boundary value of the

impedance of the input circuit of the amplifier. The degree of suppression of fluctuations of the active element in a photoelectric preamplifier employing simple noise compensation is computed as a function of the frequency band and the depth of compensation. Figures 2; references: 5 Russian.  
[111-6900/5915]

UDC 621.382.232

#### SYSTEM FOR MEASURING PERSISTENCE OF LUMINESCENT SCREENS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 17 Sep 84) p 62

KUPREVICH, V. V., VASILYEV, P. Ya., ZELENOV, A. A., SEMENOV, Ye. P. and TSVETKOV, A. I.

[Abstract] A system is described for measuring monolithic cathode luminophor screen persistence ranging from  $10^{-8}$  to 10 seconds. The system operates by using an electron beam to excite the screens being tested; the afterglow is recorded with the help of a photomultiplier tube on an oscilloscope. The device has been used to investigate the persistence of screens with different rare-earth activators. Figures 2; references: 3 Russian.  
[111-6900/5915]

UDC 621.382.2

#### HYDROGEN-SENSITIVE MDS-STRUCTURE ON GaAs

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 1 Feb 84) pp 1648-1650

KULIYEV, B. B.

[Abstract] While metal-dielectric-semiconductor structures and metal-semiconductor diodes with an  $A^{III}B^V$  compound such as GaAs as the semiconductor have many characteristics which are not worse than those of conventional structures and diodes based on silicon, they also offer several advantages to be considered in development of new microelectronic and optoelectronic devices. Since a Pd- $Ge_3N_4$ -GaAs structure has already been successfully produced, an experimental study was made for the purpose of determining the reversibility of changes in its capacitance-voltage characteristic upon adsorption and desorption of hydrogen. A specimen of that structure was produced so as to ensure minimum density of surface states at the dielectric-semiconductor boundary, namely by chemical deposition of the  $Ge_3N_4$  layer from the gaseous phase on the GaAs crystal thus avoiding destructive high-temperature treatment. The substrate was an n-GaAs crystal ( $n = 7 \cdot 10^{10} \text{ cm}^{-3}$ ) with a <100> orientation

and an epitaxial layer. Prior to deposition of the dielectric, this crystal was cleaned in an ultrasonic bath with trichloroethylene, acetone, methanol, and deionized water, etched with a  $\text{NaOH}:\text{H}_2\text{O}_2:\text{H}_2\text{O} = 1:2:100$  solution, immersed in an  $\text{HF}:\text{H}_2\text{O} = 50:50$  solution for removal of oxides and then slightly etched with HCl in a reactor. The dielectric was obtained by pyrolytic decomposition of  $\text{GeH}_4$  and  $\text{NH}_2 \cdot \text{NH}_2$  in a reactor with a radio-frequency heater. After the structure had been annealed at  $400^\circ\text{C}$  in a nitrogen atmosphere for 10 min, a palladium barrier contact was deposited on  $\text{Ge}_{3/4}\text{N}_{1/4}$  through a mask under vacuum and an indium ohmic contact was deposited on GaAs. The specimen was tested in an open hydrogen stream as well as in a closed vessel containing hydrogen. Its capacitance-voltage characteristic was measured at 1 MHz, before and after hydrogen adsorption. Changes of plane-bands voltage and capacitance were measured as functions of time during hydrogen adsorption under a constant bias voltage. The results reveal that adsorption of hydrogen causes a shift of the capacitance-voltage curve toward more negative voltages, but no change in capacitance within the hydrogen buildup region and thus no change in either the permittivity or the effective thickness of the dielectric layer. Accordingly, a Pd- $\text{Ge}_{3/4}\text{N}_{1/4}$ -GaAs diode appears to be eminently suitable for use as hydrogen detector. Figures 3; references 15: 4 Russian, 11 Western.  
[66-2415/5915]

UDC 621.319.01.001

#### DETERMINATION OF OPTIMUM FORM OF ELECTRODE IN ELECTROSTATIC SUSPENSION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 29 Jun 84) pp 54-57

BALYASNIKOVA, A. N., Leningrad Institute of Precision Mechanics and Optics

[Abstract] In the design and utilization of electrostatic suspensions it is necessary to take into consideration the higher value of the field intensity at the edge of the electrode as compared with sections removed from the edge. Consequently, the problem arises of choosing a configuration of the electrode such that the field intensity will not increase during an approach to the edge of the electrode and remains close to the value of the intensity at the center of the electrode. The problem is solved approximately on the basis of an expression found for the electrostatic field at the gap of the suspension with allowance made for the edge effect. The paper was recommended by the Department of Electrical Engineering. Figures 3, references: 2 Russian.  
[90-6415/5915]

UDC 681.142.621

VIBRATION PROTECTION PROPERTIES OF ELECTROMAGNETIC SUSPENSION DEVICES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 27 Dec 84) pp 49-54

VYSHKOV, Yu. D., Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] The vibration protection properties of electromagnetic suspension devices of various designs are established and a comparison of these properties in known and proposed new devices is made. The paper was recommended by the Institute. Figures 6; references: 5 Russian.

[90-6415/5915]

UDC 537.533.3

INFLUENCE OF PARAMETERS OF MULTIDYNE-SCREEN SYSTEM ON IMAGE QUALITY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 27 Dec 84) pp 17-18

SHIMANSKAYA, A. V. and YEVDOKIMOV, V. N.

[Abstract] A previous work developed a computer model of the process of amplification and formation of the image of an individual channel in a multidyne-screen system. The process of amplification of the electron flux in a channel was modeled by the Monte Carlo method. The distribution of current density in the image of the channel and its frequency-contrast characteristics were determined from electron arrival coordinates on the screen. The model was used in this article to study the influence of depth of the conducting coating at the output of the channel on distribution of current density in the screen image. The set of frequency-contrast characteristics was computed for various values of thickness and expressed as a set of curves. Increasing atomization depth decreases the gain due to precipitation of a significant fraction of the electrons on the coating. Figures 4, references 5: 4 Russian, 1 Western.

[69-6508/5915]

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

UDC (62-503.53:62-83:621.9.06).001.24

SYNTHESIS OF TRACKING DRIVES OF MACHINE TOOLS WITH ELASTIC ACTUATING MECHANISM

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 3 Dec 84) pp 44-46

SIROTIN, A. A., doctor of technical sciences, and POZDEYEV, D. A., engineer, Moscow Electrotechnical Institute

[Abstract] This study analyzes the structure of tracking drives for computer numerical controlled machine tools that use the difference between the speeds in angles of the actuating motor and mechanism for purposes of compensation. The tracking drive is simulated by realizing a selected position of the poles and zeroes of the transfer function of the closed automatic control system that provides the required quality of the transients. A method is presented for selecting the adjustment parameters, and the influence of current limiting on the operating dynamics is investigated. The frequency bandwidth of the tracking drive described by the transfer function obtained is estimated. Analysis of the transfer function indicates that the system is astatic with respect to excitation. The range of input signals for which the system remains in the linear region is found. Figures 2; tables 2; references: 5 Russian.  
[110-6900/5915]

UDC 681.7.02

PROGRAM FOR AUTOMATED FINISHING OF LARGE-SCALE OPTICAL PARTS BY SMALL TOOL

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 6 Feb 85) pp 35-37

SAVELYEV, A. S., SEMENOV, A. P., KATAGOROV, F. K. and ABDULKADYROV, M. A.

[Abstract] Software written for the SM-4 minicomputer is described for constructing topographic maps of surfaces finished on the automated AD-700 system. The software incorporates programs for processing the results of interferogram measurements, averaging the results of processing several interferograms, and calculating the technological processing modes, the proposed topographic map after processing, the tool trajectory, and producing the control punch tape for the computer numerical control device. The programs are written in FORTRAN

and run under the RAFOS-1 operating system. Needed data is transferred from one program to another via disk data files. Use of the software in finishing a spherical part made of S0-115M devitrified glass 412mm in diameter. The results indicate that the software works well in finishing large optical parts, with standard deviation not exceeding  $\lambda/40$ . Figures 1; references: 2 Russian. [111-6900/5915]

UDC 621.39

#### CONCERNING THE ANALYTICAL DESIGN OF STOCHASTIC DISCRETE FOLLOW-UP SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian No 9, Sep 85 (manuscript received 20 Nov 84) pp 14-19

KUZKIN, A. A. and CHURAKOV, Ye. P., Ryazanskiy Radioengineering Institute

[Abstract] The methods of analytical design of regulators are used for construction of stochastic discrete follow-up systems for a quasi-determinate signal distorted by random noises of the type of discrete white noise. The results are presented of the statistical modelling of a follow-up system functioning according to the optimum algorithm obtained. The paper was recommended by the Department of Higher Mathematics. Figures 2; tables 1; references 6: 5 Russian, 1 Western (in Russian translation).  
[90-6415/5915]

UDC 62-83

#### SYNTHESIS OF ABSORPTION DISTURBANCE REGULATOR FOR SERVO ELECTRIC DRIVE WITH ELASTIC MECHANICAL TRANSMISSION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 18 Nov 83) pp 23-27

GONCHAROV, A. S., engineer, and MIRONOV, S. M., candidate of technical sciences

[Abstract] The paper is concerned with synthesis of an absorption disturbance regulator with a direct current motor with a flexible mechanical drive used as a control object. A sum of random step-LIKE linear disturbances is approximated leading to the formulation of a state vector which is the basis for corrective regulation. A block diagram is shown of an electric drive and the regulator. Figures 2; references 2: 1 Russian, 1 Western.  
[263-6415/5915]

UDC 621.13.13

OPTIMAL CONTROL BY PROPELLER DIRECT-CURRENT DRIVE FOR OCCASIONAL OSCILLATORY MOTION REGIME OF SHIP

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received after revision 20 Jun 83) pp 33-35

KUTASIN, B. P., professor Odessa Higher Engineering Maritime School imeni Lenin Komsomol

[Abstract] A 1964 work by Kutasin considered the problem of decreasing losses by a propeller direct-current drive during movement of a ship in a disturbance. However, on the basis of a 1949 work by I. Ye. Minnovich, it is customary to assume that the oscillating motions of the ship are regular. In a first approximation such a proposition is valid. However, the actual oscillations of a ship during its movement in a disturbance have a random nature and the dynamics of a complex. The present work considers a ship in a regime of occasional oscillating motion. On the basis of the theory of random functions, analytic expressions are determined by the variational method for the current and velocity of a propeller direct-current drive, corresponding to the minimum losses in the main circuit during occasional oscillating motions.

References: 5 Russian.

[263-6415/5915]

UDC 62.83:621.316.71

INCREASE OF HIGH-SPEED RESPONSE OF ASTATIC SYSTEMS FOR STABILIZATION OF ELECTRIC DRIVE VELOCITY

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 6 Apr 84) pp 36-42

PRUDKOV, M. L., candidate of technical sciences, chief specialist, Elektrotyazhkhimiprojekt State Design Institute (Dnepropetrovsk)

[Abstract] The dynamic characteristics of astatic systems for stabilization of the speed of an electric drive (SAS) are compared with servo system type numbers of the first (SAS1), second (SAS2), and third (SAS3) orders. The comparison is made during their operation within the limits of the linearity boundaries and in the nonlinearity region with adjustment in the latter case of the principles of control, optimum with respect to the speed of response. A block diagram of the SAS is shown and block diagrams of the SAS1-SAS3 speed regulators are presented in a table. It is shown that with use of combined control with high-speed measuring of the static moment, realization of limits with respect to the speed of response of SAS is simplified. Figures 4; tables 1; references: 3 Russian.

[263-6415/5915]

UDC 621.316.726.001.1

HIGHLY PRECISE ELECTRIC DRIVE WITH FREQUENCY-MODULATING VELOCITY PICKUP

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 11 Nov 83) pp 52-56

STAROVEROV, B. A., candidate of technical sciences, assistant professor,  
Ivanovo Power Engineering Institute; and TEREKHOV, V. G., assistant, Ivanovo  
Power Engineering Institute

[Abstract] The paper describes a highly-precise system for stabilization of the angular velocity of an electric drive based on a phase synchronization circuit. A block diagram is presented of an electric drive with a frequency-modulating velocity pickup. It is shown that use of such a system considerably expands the range of velocity control without reducing the precision of control. The possibility exists of using such pickups for serially-produced synchros and rotary transformers. Because of the simultaneous change over the entire range of the standard frequency and the frequency of the supply for the velocity pickup, rigorously fixed stages with discreteness of the order of 0.1 percent are provided. Figures 1; references 4: 3 Russian, 1 Western.  
[263-6415/5915]

UDC 621.314.5

ANALYSIS OF TRANSMISSION FACTOR OF SELF-EXCITED VOLTAGE INVERTER

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 28 Oct 83), pp 48-52

CHAPLYGIN, Ye. Ye., candidate of technical sciences, assistant professor,  
Moscow Power Engineering Institute; and ANTOSHINA, O. V., engineer, Moscow  
Power Engineering Institute

[Abstract] The paper analyzes the transmission properties of a self-excited voltage inverter (SEVI), including SEVI with pulse-duration modulation. A method of deriving the dynamic transmission factor of a converter is proposed, and its dependence on the frequency of a feedback signal and the modes of operation of a SEVI are investigated. The paper is a continuation of a 1981 work by Chaplygin. Pulsation in the SEVI is not considered in the paper because it requires an independent investigation. Figures 3; tables 2;  
references: 5 Russian.  
[263-6415/5915]

UDC 62-83:621.313.3

ESTIMATE OF OPTIMUM FREQUENCY REGION FOR PULSE CONTROL BY ELECTRIC DRIVE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 28 Jul 82) pp 78-84

GAFIYATULLIN, R. Kh., doctor of technical sciences, professor, Chelyabinsk Polytechnical Institute; GELMAN, Ye. A., engineer, KARETNYY, O. Ya., candidate of technical sciences; and YUDKEVICH, M. L., candidate of technical sciences, coworker, Chelyabinsk Polytechnical Institute

[Abstract] A method is presented which makes it possible to determine the optimum region of frequency control in an electric drive with pulse-width modulation, in order to ensure a wide range of control and a high smoothness of motion. Components of the electric drive are listed. The results of calculations were checked by means of digital simulation and tests on a model.

Figures 4; references: 6 Russian.

[263-6415/5915]

UDC 62-83:681.325.5.181.4

SYNTHESIS OF COMBINED SYSTEM OF POSITIONING ELECTRIC DRIVE WITH DIGITAL SPEED GOVERNOR

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 3, Mar 85 (manuscript received 17 Apr 84) pp 103-111

KOTSEGUB, P. Kh. candidate of technical sciences, assistant professor, Donetsk Polytechnical Institute; and GUBAR, Yu. V., assistant, Donetsk Polytechnical Institute

[Abstract] The paper considers the digital-analog system of a positioning direct-current rectifier drive, realized on the principle of subordinate control. The analog part of the system--circuit of current control--is constructed according to an optimum modulus. Block diagrams are shown of a positioning electric drive with mixed control, and a system for positioning control. The following items are included in the discussion: 1) Determination of parameters of circuit for speed regulation; 2) Determination of amplification factor of positioning circuit; and 3) Determination of correcting coefficients. The system considered can find use in mechanisms operating in startup-braking regimes in which a high precision of control of position is required. The system can be realized by means of contemporary microprocessing technology. Figures 6; tables 2: references: 6 Russian.

[263-6415/5915]

UDC 62-83:621.313.2

CALCULATION OF PARAMETERS OF QUASI-STEADY STATE REGIME OF DISCRETE-PHASE ELECTRIC DRIVE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 85 (manuscript received after revision 25 Jul 83) pp 116-120

ZAZHIRKO, V. N., doctor of technical sciences, professor, Omsk Polytechnical Institute; and CHULOVSKIY, V. I., chief, Electronic Computer, Calculating Center, Omsk Institute of Railroad Transport Engineers

[Abstract] The paper describes the parameter computation procedure involved and presents the results of the calculation of a quasi-steady state regime of a low-velocity discrete-phase electric drive of return-rotary motion with a direct-current non-contact motor. The procedure can be used during analysis and synthesis of similar systems. Figures 5; references: 2 Russian.

[263-6415/5915]

UDC 658.52.011.56.001.2:658.516

ASSURING OPERABILITY OF COMPLEX SYSTEMS DURING DESIGN PROCESS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 11-13

KUDRYASHOV, Yu. P., engineer

[Abstract] The technical regulatory documentation covering automated technological process control systems is analyzed substantively in order to ascertain how comprehensively the system design is regulated. Excerpts from the analysis are presented that make it possible to identify imbalances in existing documentation, as well as documentation under development, with respect to regulating function indicators and operability indicators. Forty different regulatory documents were examined in areas ranging from product quality control to reliability in automated technological process control systems. Recommendations are given for modifying technical regulatory documentation substantively with respect to assuring the operability of automated technological process control systems while they are under development. Figure 1, references: 10 Russian.

[94-6900/5915]

UDC 681.586.32

CONTEMPORARY INTEGRATED TRANSDUCERS FOR MECHANICAL QUANTITIES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 14-17

STUCHEBNIKOV, V. M., candidate of physical and mathematical sciences, and TRUKHACHEV, B. S., candidate of technical sciences

[Abstract] The development of semiconductor mechanical sensors is described. The metrological and operating characteristics of silicon strain gauges are considered. The status of the development and production of integrated mechanical transducers is reviewed. Figures 3, table 1, references 34: 22 Russian, 12 Western.

[94-6900/5915]

UDC 681.331.34

MICROCOMPUTER-BASED DIGITAL-ANALOG DEBUGGING COMPLEX

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 pp 31-32

MOSKALENKO, A. A., KULAKOV, G. T., candidates of technical sciences and KOROBSKIY, V. A., KULAKOV, A. T. and MARTINKEVICH, V. Ye., engineers

[Abstract] A digital-analog debugging complex for setting up control systems is described. The complex is based on the Elektronika-60M microcomputer, and is used in the laboratory for developing optimal adaptive control principles through structural and parametric system optimization, debugging microcomputer-based digital-analog adaptive automated regulation systems, developing direct digital control principles, debugging microcomputers, debugging microcomputer software, developing methods for optimal adjustment of the actual control equipment employed with adaptive automated regulation systems, investigating the noise tolerance and errors of digital-analog debugging complexes, and experiment automation. The system supports semiautomatic, automatic, and supervisor-controlled operation. Figure 1; references: 5 Russian.

[94-6900/5915]

UDC 621.391.3

INITIATING SIGNAL UNIT FOR ELECTRONIKA-60 MICROCOMPUTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 85 p 33

BORODIN, I. V., RODIONOV, V. V. and KULESHOV, V. A., engineers

[Abstract] An initiating-signal input unit based on an Electronika-60 microcomputer is described. The unit, which is designed for use in developing real-time test and control systems in which large numbers of initiating signals must be processed, incorporates an initiating signal switch, an address code generator, a random access memory for storing initiating signals, a comparator, a multiplexor, a data register, a status register, an interrupt vector address register, and channel transceivers. The structural diagram of the unit is presented and explained.

[94-6900/5915]

## INSTRUMENTATION AND MEASUREMENTS

UDC 531.717.8.082.531

### REFLECTOMETRIC ROUGHNESS MEASUREMENT OF MIRRORS PRODUCED BY DIAMOND TURNING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 26 Feb 85) pp 11-13

BOGDANOVA, G. A., ZHEVLAKOVA, T. A., LYUBARSKIY, S. V., SKRELIN, A. L. and SHOROKHOV, O. A.

[Abstract] This study investigates the possibility of reflectometric determination of the standard deviation of the roughness profile to estimate the roughness of metal mirror surfaces produced with the help of a single-crystal diamond tool. The height of microscopic surface irregularities are determined by measuring the signals from the diffuse and total reflected fluxes from the mirror. Reflectometric measurements of a test surface are compared with direct profile measurements made using a profilograph. The standard deviation of the surface roughness obtained by both methods are found to be the same, indicating that the proposed reflectometric method can be used for diamond-turned surfaces regardless of the distribution of the heights of the irregularities. Figures 2; table 1; references: 3 Russian.  
[111-6900/5915]

UDC 535.317.2

### FLEXURAL STRENGTH LIMIT OF OPTICAL GLASSES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 10 May 84) pp 60-61

MATVEYEV, A. V.

[Abstract] Experimental investigation of the mechanical properties of TK116 and TK21 optical glasses by central symmetrical bending is described. The stress data was processed statistically to find the average destruction stress, the abrasion factor, the standard deviation, and the asymmetry and excess. The experimental strength limit data for TK116 glass is found to agree poorly with normal and log normal distributions; however, the agreement for TK21 glass is good. The findings can be used in assessing the strength of optical parts made of the brands of glass in question. Figures 2; tables 2; references: 6 Russian.  
[111-6900/5915]

UDC 621.317.772.006:621.3.089.6

CHECKING-TESTING SYSTEM FOR TESTING AND MEASUREMENT LABORATORIES

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 7-9

MATVEYEV, A. A. and KРИVOTSYUK, V. I.

[Abstract] A study is made of a checking-testing system to be used to check or test the hardware and software of functionally complex digital devices containing microprocessors as a part of the metrologic servicing of digital measurement instruments in a laboratory. The device is based on an Elektronika-60 microcomputer plus a terminal for input of commands, a punch tape reader-puncher and an interface unit to connect the microcomputer to additional I/O devices as well as the devices being tested. The operation of the device is based on the assumption that the code combination at the output of the device being tested at a certain moment in time is unambiguously determined by the code combination at its input plus the internal state of the device, which depends on the sequence of code combinations previously input. The process of testing is reduced to repeating various sequences of input code combinations and testing the code combinations at the output in comparison to the codes which should theoretically be produced. The device allows testing of instruments with combined configurations including both hardware and software. It is a flexible and convenient means for testing digital measurement instruments and allows a significant expansion in the list of devices which can be tested. Figures 2, references: 7 Russian.

[55-6508/5915]

UDC 681.325[088.8]

ANALYSIS OF INSTRUMENTAL ERROR IN CYCLICAL TRANSFORM OF ROTATING TRANSFORMER SIGNALS TO ANGLE CODE

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 10-12

DOMRACHEV, V. G. and PODOLYAN, V. A.

[Abstract] The purpose of this work was to determine the regularities relating error  $E_2$  in a converter to the errors in the elements included in the converter. Errors in elements are considered in accordance to the functioning algorithm of each element, allowing their influence on overall operation to be determined analytically. However, the algorithmic model is quite idealized, meaning that the results presented are based on theoretical conclusions as well as experimental data. The components of instrumental error in the idealized model of a transducer are studied. An Elektronika D3-28 microcomputer was used to determine the accuracy characteristics of a transducer and construct a graph of the experimental distribution of error probability  $E_2$ . The statistical rules obtained were matched with the theoretical distribution. Figures 3, references: 7 Russian.

[55-6508/5915]

UDC 535.33:621.317.343.2

RECONSTRUCTION OF MARGINAL SPACE-FREQUENCY WAVE FIELD SPECTRA BY DIFFRACTION TOMOGRAPHY

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 17-19

MASLOV, V. K. and SMIRNOV, V. A.

[Abstract] The problem is studied of restoring the three-dimensional structure of the wave field of a complex source based on its linear projections. The measurement of the external field and internal reference signals in a common time scale is described. With sufficient signal/noise ratio to allow measurement of holographic projections, parametric algorithms with greater resolution should be used, which allows improvement in the quality of the reconstructed acoustical image. Figures 4; references: 6 Russian.

[55-6508/5915]

UDC 389.14:535.247.4

NONMOVING POINT METHOD IN MEASUREMENT OF MARGINAL SPACE-FREQUENCY SPECTRA

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 19-22

VASILYEV, S. S., MASLOV, V. K. and TSYGANKOV, S. G.

[Abstract] The solution of the problem of restoring an acoustical image in narrow frequency bands is based on inversion of the diffraction integrals of various types with kernel depending on the propagation of waves in space and the geometry of the measurements. A mathematical model of a radiator and the major operations of spatial focusing in the temporal area are studied. It is found that the signal of a scanning receiver is nonsteady due to the presence of variable nonlinearly changing time delays in the signal, which is manifested as Doppler shift of the spectral components generated by the radiator. A procedure is studied for compensating for time delays and related errors. The nonmoving point method described, using radiator reference signals, allows measurement of marginal space-frequency spectra of complex radiators with both coherent and noncoherent radiation. The spectrum of a wideband signal can be found with great resolution for an arbitrary fixed point in the radiator aperture and the spectral composition of independent radiators can be distinguished even if their location in the aperture of the complex radiator coincides.

References 12: 9 Russian, 3 Western.

[55-6508/5915]

UDC 621.753.1:62-422:531.7.089.6

POSSIBILITY OF INCREASING ACCURACY OF DIFFRACTION METHOD OF MEASURING  
MULTILAYER DIELECTRIC CYLINDERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 27-28

VORONTSOV, A. A. and MIROVITSKAYA, S. D.

[Abstract] The area of application of known expansions with respect to cylindrical functions in the process of construction of calibration curves for use in the diffraction method can be significantly expanded by the introduction of new special functions which represent combinations of cylindrical functions. The new functions have good computational properties. The use of the new special functions has allowed numerical solution of the problem of diffraction of a plane wave on a multilayered cylinder of great radius, yielding a large series of calibration curves and significantly increasing the accuracy of the diffraction method for large diameter cylinders. Figures 2, references 7: 6 Russian, 1 Western.

[55-6508/5915]

UDC 006.065:389.14

SYSTEMATIZATION AND STANDARDIZATION OF METROLOGICAL AND TECHNICAL  
CHARACTERISTICS OF FLAME PHOTOMETERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 34-36

KARABEGOV, M. A.

[Abstract] The operation of flame photometers is described and characteristics used to classify the devices are noted. Metrologic characteristics of the photometers are evaluated by means of test solutions. The dynamic characteristics of the photometers include the time required to make readings. Safety characteristics are also important in the classification of the devices. State standard 22744-84 establishes differential indices corresponding to the requirements of various categories of quality of flame photometers including the degree of automation, mass, power consumption, limits of random component of error and variations of readings, dynamic characteristics and service life.

[55-6508/5915]

UDC 621.37.39:621.384

USE OF TIME-FREQUENCY APPARATUS TO IMPROVE THE TECHNOLOGY OF TELEVISION AND  
RADIO BROADCASTING

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 38-39

BORISOCHKIN, V. V., FEDOROV, Yu. A. and SOKOLIN, A. A.

[Abstract] The State time and frequency service utilizes equipment installed at the television technical center in Moscow and radio and television stations in other cities to transmit standard time and frequency signals. It is therefore desirable to use equipment of this service installed at television stations to improve the technology of television and radio broadcasting. An experimental time-frequency apparatus used to transmit time signals on the sixth row of the television signal and to support the technological requirements of the television broadcast center was installed at the Moscow television center in 1979. Characteristics of the signal broadcast are noted. Local television stations can detect the time signals broadcast with the major nationwide television signals and use them to improve the technology of television and radio broadcasting. References: 4 Russian.

[55-6508/5915]

UDC 389.14:536.3.089.6

INSTALLATIONS FOR TESTING PYROMETERS BASED ON BROAD APERTURE ABSOLUTE  
BLACK BODY MODELS IN THE RANGE FROM -20 TO +1000°C

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 46-47

CHISTYAKOV, V. A., SHALANKEVICH, A. M. and YASYUKOV, V. B.

[Abstract] Three installations have been tested for calibration of APIR-S pyrometers and other special pyrometers with sighting indices of one fifth and higher in the range from -20 to +1000°C. They are the IT-80-1, IT-250 and the ShT-N2 radiator. The IT-80-1 is designed for calibration and testing of pyrometers in the 300-100°C range and consists of the IT-80-1 radiator, a stage with a rotating device and control panel for regulation and measurement of temperatures. The IT-250 device is used for calibration and testing of pyrometers operating at 200-600°C, and consists of the IT-250 radiator, a rack with pyrometer holders and a control panel. The devices allow calibration and testing of operating APIR-S pyrometers as well as practically any other type of pyrometer operating at -20 to +1000°C with an error of 0.5-0.7%.

Figures 2; references: 3 Russian.

[55-6508/5915]

UDC 006.63:620.1:536

CERTIFICATION OF NEW THERMOELECTRODE MATERIALS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 47-48

DOBROVINSKIY, I. Ye. and PAVLOV, B. P.

[Abstract] A study is made of the method of developing and certifying thermoelectrode materials. Specimens of thermoelectrode materials must be tested for homogeneity, preferably by the method of two media. The method is described. Calibration of specimens is then performed by electrode comparison, with the specimen with the minimum heterogeneity calibrated in vapor with platinum at least five times. The results produced are statistically processed and reproducibility of calibration of the specimen is determined. Estimates of the nominal calibration characteristics, permissible deviation of thermal emf from the nominal and thermoelectric heterogeneity of the material are then produced by measuring a two-meter section. Since there are at present no standards for these characteristics, the values must be recorded in the certificate of metrologic attestation of the thermoelectrode materials.

References: 7 Russian.

[55-6508/5915]

UDC 621.373.54:534.321.9.08

PULSE GENERATOR FOR CIRCULAR SYSTEM FOR MEASUREMENT OF ULTRASONIC OSCILLATION SPEEDS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 52-53

OVCHINNIKOV, A. G.

[Abstract] The simplest solution to the problem of starting a circular circuit which requires startup is the use of a pulse generator with a synchronization circuit which, when a synchronizing pulse is absent, outputs pulses with a repetition frequency less than the minimum possible circulation frequency, then upon receipt of an input pulse which has traveled around the circuit, acts like a waiting circuit. A significant increase in repetition period can be achieved by introducing a FET multivibrator to the generator. A schematic diagram of such a device is presented. The circuit is used together with disk converters of a piezo-ceramic material. The length of pulses generated is approximately 0.2  $\mu$ s, leading edge length 15 ns. Delay in operation of the generator is not over 15 ns. Figures 1, references: 4 Russian.

[55-6508/5915]

MAGNETICS

UDC 621.314.222.6:621.318.1-415

ANALYSIS AND MATHEMATICAL DESCRIPTION OF MAGNETIZATION CHARACTERISTICS OF ANISOTROPIC COLD-ROLLED ELECTROTECHNICAL STEELS

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 22 Oct 84) pp 34-37

KALININ, Ye. V., LYUBIVYY, V. I., PERSHIN, V. V., TILK, V. T., engineers

[Abstract] The magnetic anisotropic characteristics of cold-rolled steels are investigated experimentally in order to find the vector magnetization characteristics. The minimum amount of experimental data needed for an analytical description of the characteristics  $H$  ( $B$ ) of cold-rolled electrotechnical steels is determined. Analytical expressions are derived for describing these characteristics mathematically. An analysis of the M6 cold-rolled steel produced by the Italian Terni Company is described. A comparison of the analytical results with experimental findings on various steels indicates good correspondence. The proposed analytical description of the vector magnetization characteristics can be used for any sort of magnetic anisotropy of electro-technical sheet steel, including hot-rolled. Figures 4; tables 1; references: 7 Russian.

[110-6900/5915]

UDC 621.318

CALCULATION OF STABLE STATE OF CYLINDRICAL MAGNETIC DOMAIN CLOSE TO APPLIQUE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 9, Sep 85 (manuscript received, after revision 5 Jun 84). pp 12-19

TELEGIN, A. P., junior research worker, Simferopol State University; and STADNIK, I. P., candidate of technical sciences, assistant professor, Simferopol State University

[Abstract] The quasi-static interaction of a cylindric magnetic domain with a thin permalloy applique is investigated in order numerically to obtain data concerned with the configuration and arrangement of the domain in the immediate vicinity of the applique, as a function of the geometrical and magnetic parameters of the system, and the magnitudes of the controlling field and displacement

field. The following are considered: 1) Form and location of the domain in an arbitrary magnetic field; 2) Scattering field of applique; and 3) Set of equations and algorithm for solution of self-consistent problems. Figures 7; references 10: 8 Russian, 2 Western.

[109-6415/5915]

UDC [621.335:625.2.012.858:538.65]:621.313.13-12

EXPERIMENTAL INVESTIGATION OF SUPERCONDUCTING MAGNETS ON MODEL OF SINGLE-POINT ELECTRODYNAMIC SUSPENSION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received 12 Jun 84) pp 83-87

VASILYEV, S. V., candidate of technical sciences, scientific worker, Leningrad Polytechnical Institute; KURAKIN, A. V., junior research worker, Leningrad Polytechnical Institute; LUPKIN, I. D., candidate of technical sciences, All-Union Scientific-Research Institute of Electrical Machinery, Leningrad; and TSYGAN, S. N., junior research worker, Leningrad Polytechnical Institute

[Abstract] The accuracy is experimentally investigated of calculations concerned with energy losses accumulated in superconducting suspension solenoids in a "frozen" flux regime, with vertical oscillations of the magnets relative to the levitated array. A diagram is presented of the experimental installation used. Figures 1; tables 1; references 5: 4 Russian, 1 Western.

[109-6415/5915]

MICROWAVE THEORY AND TECHNIQUES

UDC 621.372.543.2:537.6

NARROW-BAND FILTRATION OF MICROWAVE SIGNALS WITH MAGNETOSTATIC WAVES  
EXCITED IN YIG FILMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 8, Aug 85  
(manuscript received 29 Aug 84) pp 1513-1521

VASHKOVSKIY, A. V., ZUBKOV, V. I., LEBED, B. M. and NOVIKOV, G. M.

[Abstract] Use of magnetostatic waves excitable in thin ferrite films for processing microwave signals is considered, particularly excitation of magnetostatic waves in YIG films for narrow-band filtration of microwave signals. Various methods of excitation and correspondingly various configurations of narrow-band filters are analyzed for a comparative evaluation with the aid of experimental data. A microstrip line can serve as exciter and with a YIG film placed on it act as either band-elimination or band-pass filter. The amplitude-frequency characteristic of such a filter depends largely on the microstrip-film geometry. The simplest configurations are a meander as band-elimination filter, a grating as band-elimination or band-pass filter, and a ladder as retarding system which passes signals only where a film is present. These configurations were tested, using periodic structures of 20 microstrip lines. First, all microstrip lines are equally long (2 mm), then they were

apodized with their length varying as either the  $\frac{\sin x}{x}$  function or the  $\cos^2 x$

function of the transverse coordinate. In addition were tested two special exciter-filter designs, two microstrip lines side by side under one YIG film and one microstrip line between two YIG films in a lap configuration for utilization of the resonance coupling between both films, this coupling being dependent not only on the distance separating the films but also on the area of overlap. The second configuration with YIG films as the principal elements was found to yield a more selective filter than configurations with microstrip lines as the principal elements. The authors thank Yu. V. Gulyayev for steady attentiveness and many discussions, also A. V. Voronenko, V. N. Kildishev, Ye. Z. Petrunkin, A. V. Stalmakhov and S. V. Yakovlev for assisting with experiments. Figures 7; references 14: 9 Russian, 5 Western.

[66-2415/5915]

## MICROWAVE INPUT AMPLIFIERS FROM STANDPOINT OF ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
 (manuscript received, after revision 21 Dec 84) pp 3-13

ALGAZINOV, E. K. and MNOYAN, V. I.

[Abstract] Performance characteristics of low-noise microwave amplifiers are analyzed from the standpoint of electromagnetic compatibility, for a comparative evaluation of their suitability as input stages of receiver equipment. As criteria for this application are considered interference lockout, change in noise factor, amplitude-phase cross-conversion, amplitude-amplitude and amplitude-phase cross-modulation,  $2f_1 - f_2$  and  $f_1 + f_2$  as well as  $f_{c+} (f_1 - f_2)$  intermodulation, and harmonic generation. All these effects in an amplifier are quantified in terms of parameters characterizing its frequency selectivity with respect to each. A simple engineering method has been proposed for determining the values of these parameters, when interference occurs at the center of the operating band, this method involving the "point of intersection" between the single-signal amplitude characteristic and the third-order-intermodulation amplitude characteristic in the dB-dB plane. Nonlinear effects are most expediently evaluated with the aid of Volterra-function series. Other factors taken into consideration are stiffness of the electrical input characteristics, also limiter characteristics and transient or dynamic characteristics. On the basis of this set of criteria and with the aid of available technical-scientific research data, it is possible to assess the merits and the drawbacks of each known type of low-noise microwave amplifier. The main five types are traveling-wave-tube and backward-traveling-wave-tube amplifiers, backward-wave amplifiers, transverse-wave parametric amplifiers, semiconductor parametric amplifiers, and transistor amplifiers. The authors thank I. V. Lebedev for attentiveness and valuable comments. Figures 1; tables 2; references 77: 71 Russian, 6 Western.

[80-2415/5915]

## AUTOMATIC FREQUENCY REGULATION OF KLYSTRON AND BACKWARD-WAVE TRAVELING-WAVE TUBE MICROWAVE OSCILLATORS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85 (manuscript received 25 Dec 84)  
 pp 56-58

AGANBEKYAN, K. A., ZHURAVLEV, V. Ye., KULIKOV, V. V. and PLOKHOTNYUK, Ye. F.

[Abstract] Automatic wide frequency regulation with frequency locking was developed for klystron and backward-wave traveling-wave tube microwave oscillators used for spectroscopy of atoms and molecules as well as for astrophysical research and technical applications in the 16-460 GHz frequency range.

The automatic system includes a Nord-10 computer and standard CAMAC equipment with crate controller in addition to a Ch3-38 frequency meter, a YaZCh-42 frequency converter and a Ch5-13 frequency converter, an F270 amplifier-matcher, a Ch6-31 frequency synthesizer with a digital-to-analog converter controlling the reference frequency during electronic scanning of the oscillator frequency range, three motors running at 2 rpm, a 16-channel analog-to-digital converter with buffer for processing the signals from two frequency locking indicators, two S4-25 spectrum analyzer, and two phase-lock frequency control modules. The software for this system was automatically generated by the UNILIKE system in IEL language within the IVSKP shared use measurement and computation system including GRINEKS graphical mockup procedures. The scanning speed in approximately 100 kHz steps is roughly 16 MHz/min and the stability of the frequency lock is within  $10^{-3}$ . Figures 1; references: 13 Russian.  
[80-2415/5915]

UDC 621.372.8.049.75

EXPERIMENTAL INVESTIGATION OF 90-DEGREE BENDS IN STRIPLINES AND MICROSTRIP LINES

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 3 Aug 83) pp 1300-1306

SLEDKOV, V. A., RZHEVSKAYA, L. A. and RYAZANOV, V. D.

[Abstract] This paper reviews studies on matched 90-degree bends in striplines and microstrip lines. Because the compared studies work with different parameters, the comparison is made with reference to the length of the perpendicular dropped from the straight edge of the 45-degree bevel used to make the 90-degree turn to the opposite end of the line. The effective permittivity of striplines is investigated and shown to differ from the permittivity of the substrates. Empirical formulas are derived for the optimal values of the 45-degree bevels and the optimal length of matched 90-degree bends in striplines and microstrip lines. The optimal width-to-height ratio for a 45-degree bevel and a 90-degree bend in a microstrip line is found to be independent of the substrate material, and to be governed only by the width of the line. The optimal ratio  $a/w$  in 90-degree bends in striplines is shown to be governed only by the width of the line, and to be independent of the permittivity of the substrate material. The frequency behavior of the equivalent length of the line can be disregarded. The findings provide comprehensive information on the parameters of 90-degree bends in striplines and microstrip lines.

Figures 6; references 11: 5 Russian, 6 Western.  
[57-6900/5915]

CRITERIA FOR SELECTION OF THERMOSTABLE PROPAGATION DIRECTIONS OF SURFACE ACOUSTIC WAVES

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85  
(manuscript received 22 Mar 83) pp 1418-1422

VOKHMIN, V. P., KOSTENKO, V. V. and YAKOVKIN, I. V.

[Abstract] Criteria are identified for selecting thermostable directions for surface acoustic waves. A physical interpretation is provided for the influence of crystal anisotropy on the temperature characteristics of surface acoustic waves. Surface acoustic waves employing rotated Y-cut quartz are defined and investigated experimentally. The thermostable propagation directions of surface acoustic waves are found to be characterized by clearly defined anisotropy of physical crystal properties. The influence of the angle of deflection of the energy flux on the temperature stability of the delay must be taken into account when implementing SAW devices. The use of doubly-rotated quartz sections for SAW devices increases the temperature stability of the delay by factors of 5-10 over a broad range of temperatures. Figures 6; references 6: 2 Russian, 4 Western.

[57-6900/5915]

MEASUREMENT OF ELECTROMAGNETIC COMPATIBILITY CHARACTERISTICS OF MICROWAVE RADIO RECEIVER INPUT DEVICES

Moscow RADIOTEKHNIKA in Russian No 9, Sep 85 (manuscript received 15 Oct 84)  
pp 87-89

ALGAZINOV, E. K., BOBREHOV, A. M., BAZHANOV, A. S. and SHVETSOV, B. N.

[Abstract] A method is proposed for measuring the electromagnetic compatibility characteristics of microwave input devices using a single setup based on the IP-5 high-sensitivity noise meter, which permits working with noise as well as monochromatic signals. An automated version of the IP-5 based complex employing an Elektronika-60 microcomputer is described making it possible to reduce the manual measurement time of two hours for one amplifier to a few minutes. The automated complex requires no special equipment, and can incorporate commercially produced G4-145 electronically tuned oscillators, which incorporate provisions for computer control. The proposed methods are helpful for measuring and testing the electromagnetic compatibility characteristics of microwave input devices, as well as automating experiments.

Figures 3, references: 6 Russian.

[102-6900/5915]

FREQUENCY CONVERSION IN RESONANT SYSTEMS WITH DISTRIBUTED INTERACTION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 8, Aug 85 (manuscript received 29 May 84) pp 1035-1042

VAVRIV, D. M., Kharkov State University

[Abstract] This study presents the results of a theoretical investigation of resonant devices with distributed interaction in the frequency-mixing mode. Down-conversion of the frequency of an external signal, which is of greatest interest in terms of developing effective millimeter-band receiving systems, is examined. The dynamics of oscillations in distributed systems are analyzed. The basic formulas are derived that describe the characteristics of millimeter-band frequency converters using different methods for transforming the external signal in the space of interaction between the beam and the field. Conversion factors on the order of 20 dB can be achieved in systems employing premodulation. Estimates of the parameters of resonant frequency converters with extended interaction indicate their promise for use as receiving systems in the millimeter waveband. Figures 3, references: 12 Russian.  
[95-6900/5915]

UDC (621.313.333.17:537.874.2).001.24

DESIGN OF ASYNCHRONOUS MOTOR EMPLOYING NONMAGNETIC TWO-LAYER CONTACTLESS ROTOR SUSPENSION

Moscow ELEKROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 16 Nov 84) pp 52-54

BANNIKOVA, L. V., candidate of technical sciences, Leningrad Electrotechnical Institute

[Abstract] An algorithym is derived for designing motors employing contactless rotor suspension that is suitable for engineering use. The rotor in the asynchronous motor in question consists of a sphere of superconducting material, or normally conducting material with high relative electrical conductivity and magnetic permeability of  $4\pi \cdot 10^{-7} \text{ Hn} \cdot \text{m}^{-1}$ . A conducting layer with axial lengths smaller than  $0.5R$  and thickness much smaller than  $R$  is applied to the sphere about the equator. A three-phase two-layer loop stator winding fits in a nonmagnetic and nonconducting cylindrical holder secured to a nonmagnetic metal housing. The motor employs no ferromagnetic cores; the scattering currents can be reduced by factors of 6 or more by channeling the main magnetic flux with the help of wedges made of a material with high relative electrical conductivity that fit in the grooves of the stator holder. The algorithym makes it possible to make a comparative estimate of different design versions and to select the optimal one for designing a machine without building a preliminary model by changing the thickness of the conductive layer, the stator and rotor materials, the power supply frequency, and the stator winding current. Figures 1; references: 2 Russian.

[110-6900/5915]

MEASUREMENT OF WINDING TEMPERATURE INCREASE IN AC ELECTRICAL MACHINERY  
UNDER LOAD

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 26 Nov 84) pp 55-57

KOZHUKHOV, G. V., candidate of technical sciences, Scientific Research Institute, Kuzbasselektromotor Production Association

[Abstract] A device is described for measuring the winding temperature increase in AC electrical machinery under load. The structural diagram is synthesized on the basis of Markov nonlinear filtering theory. A system of equations is derived that defines the structure of the sought device. The structural diagram of the device modeling the system of equations is described and explained. A physical device can be built using K140UD6 operational amplifiers and K525PS1 analog signal multipliers. A device was fabricated and tested, indicating reliable operation. Figures 4, references: 6 Russian. [110-6900/5915]

NEW TRENDS IN DESIGN OF HYDROELECTRIC GENERATORS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 85 (manuscript received 13 Dec 84)  
pp 5-8

LUKSHTAU, A. A., candidate of technical sciences, and PINSKIY, G. B., candidate of technical sciences, Elektrosila Scientific Research Institute and Leningrad Economic Planning Department

[Abstract] Since the early nineteen seventies, when 12 hydroelectric generators with a unit power rating of 500 MW at 93.8 rpm nominal speed were installed in the Krasnoyarsk GES, extensive efforts were made toward raising the unit power rating up to 1 GW and higher. One step was the construction of 10 hydroelectric generators with a unit power rating of 640 MW at 142.8 rpm nominal speed, with 720 MW peak capacity, for installation and operation in the Sayan-Shushen GES by 1985. The next step will be 1000 MW and 1350 MW hydroelectric generators now being designed at the Elektrosila Leningrad Economic Planning Department. Such ratings are made feasible by slitting the stator teeth radially and axially to various unequal depths so as to reduce excessive heating of the tips, by using nonmagnetic material for the two rotor end plates in one piece each, or bimetal and plates with their outer rings made of a titanium alloy (ZM, PTZV), nonmagnetic, for retaining the damper cage and their pressed-in inner rings made of a magnetic structural steel for retaining the poles, by reshaping the coil heads for better current and magnetic field distributions, by transposing the conductors in stator slots, by reducing the number of stator slots per pole per phase and by making it a fractional one so as to suppress the tooth harmonics with a saving of copper and insulation

material as well, and by slotting the copper bars of field coils in a periodic pattern so as to facilitate more intense air-cooling along the thus formed transverse ducts. Changeover to on-site assembly of the stator core, which eliminates the need for tight permanent joining of core segments required in preassembly, improves the reliability and lengthens the life of the generator structure in service. Assembly of the stator core by preheating it and shrinking it onto the yoke produces tensile stresses which later compensate stresses produced by magnetic pull and heating during operation. The mechanical strength of the rotor is increased by using new high-strength grades of sheet steel (23xG2AFR) for banding. An even stronger sheet steel with a yield point of 700 MPa is now being tested. The next step will be design of 1-1.5 GW hydroelectric generators. Figures 6; tables 4.  
[84-2415/5915]

UDC (621.59:538.945).001.2

#### THERMAL PROCESSES IN CURRENT LEADS OF CRYOGENIC ELECTRICAL APPARATUS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 85 (manuscript received 6 Dec 84)  
pp 8-13

KAZOVSKIY, Ye. Ya., doctor of technical sciences, professor, RUDMAN, I. Kh., engineer, and GRENADEROVA, L. A., engineer

[Abstract] The possibility of minimizing the energy losses in current leads of cryogenic electrical apparatus, refrigerator or gas liquefier, for maximum efficiency and economy of operation is examined by comparative evaluation of two methods. Both methods are based on partial cooling, self-regulated cooling or forced cooling respectively. In the latter case shunting the cold part of a current lead with a superconductor wire can further reduce the energy losses as much as to one half. A complete analysis of partial cooling with helium gas covers the steady state, the stability and reliability limit under forced cooling, the instability threshold in a fluctuating temperature field with attendant fluctuation of the coolant flow rate in the self-regulated mode, and transient effects following a sudden electrical overload or coolant cutoff. A review of published literature on the subject indicates that the problem has not been adequately researched. Estimates made by the authors indicate what data are still needed for an engineering solution. Figures 1; tables 4; references 38: 16 Russian, 1 Polish, 21 Western (1 in Russian translation).  
[84-2415/5915]

## SPECIAL FEATURES OF CURRENT LEADS FOR CRYOGENIC ELECTRICAL MACHINES

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 85 (manuscript received 6 Dec 84)  
pp 22-23

RUDMAN, I. Kh., engineer, GRENADEROVA, L. A., engineer, and GRINCHENKO, N. G., engineer, Scientific Research Institute at the Scientific Research Institute of the Heavy Electrical Machinery Plant imeni V. I. Lenin

[Abstract] Current leads for rotating cryogenic electrical machines must meet certain special requirements for operation with a coolant supplied from a refrigerator or gas liquefier in a closed-loop configuration. During normal operation not only overheating but also freezing of the hot end must not occur, inasmuch as insulation and seals are likely to fail at subzero temperatures. The current leads for the superconductor field winding must be stationary, since a sufficiently high magnetic induction in the air gap at a current level below critical requires a large number of winding turns so that soldered connections become necessary and their finite electrical resistance makes operation in the "frozen field" mode impossible. The current leads must be mechanically strong and vibration resistant, also compensation of stray pickup induced by the magnetic leakage flux is necessary. They must also be designed for maximum coolant economy. The amount of heat picked up along the leads determines their cooling requirement when the field coils are immersed in a liquid bath, while the reliability of the thermostat determines their cooling requirement in the case of forced cooling of the field coils with gas, liquid, or a two-phase medium. Thermal stability of the current leads is required not only during steady-state operation but also for some length of time after a sudden chill, overload, or coolant cutoff. The engineering design procedure based on the appropriate model of thermal processes applicable to current leads for stationary cryogenic apparatus must be supplemented so as to take into account several special features. Shunting the cold part of a current lead with a superconductor and raising the coolant inlet temperature will reduce the energy losses and thus the necessary amount of forced cooling, but this technique is limited by reliability requirements. Cooling only the hot part of a current lead will reduce the cooling requirement to approximately one half. Stable operation of current leads is possible only with heat entering on the hot side only. For ensuring a stable performance of current leads under steady as well as transient conditions it is recommended that the parameter  $IL/F$  ( $I$  - current,  $L$  - length of lead,  $F$  - area of lead cross-section) be 15-20% below its maximum value corresponding to zero heat influx at the hot end then the ratio  $G/I$  ( $G$  - mass rate of coolant) be selected correspondingly, with the Stewart number within the  $N_{St} = 50-100$  range.

Limiting the temperature of the hot end under transient conditions requires an adequate heat transfer to the ambient medium. A thicker hot part of the current lead will enhance stability during overload or coolant cutoff. For current leads made of M1 copper,  $IL/F = 20 \text{ A}\cdot\text{m}/\text{mm}^2$  and forced cooling with  $G/I = 0.054 \text{ g}/(\text{s}\cdot\text{kA})$  of helium were found to be adequate for a period of 24 s per conductor length ( $m$ ) squared under two successive overloads with  $Q_0/I$  ( $Q_0$  - rate of heat flow to the cold end) increasing by a factor of 3.5 and the

temperature of the hot end reaching 458 K. This temperature could be lowered to 353 K and even to 334 K by cutting off the heat flow to the hot end at the beginning of the first overload and then intensifying the heat transfer to the ambient medium. References 6: 4 Russian, 2 Western.

[84-2415/5915]

UDC 621.316.37:681.5:621.31

#### HIERARCHICAL CONTROL SYSTEM FOR FAULT PROTECTION

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 85 (manuscript received 4 Feb 85)  
pp 43-46

KOVALEV, V. D., candidate of technical sciences, All-Union Institute of Electrical Engineering imeni V. I. Lenin

[Abstract] The tying of power systems into grids through high-voltage a.c. or d.c. transmission lines creates a serious problem of fault protection and stability assurance, especially since the power capacity of individual plants is being continuously increased. A control system for fault protection operates in three stages: 1) control for retaining the dynamic stability of systems affected; 2) control for retaining the stability of transients till clearance of the fault; 3) control for retaining the static stability of systems affected after clearance of the fault. The control algorithms for the second stage are simply based either on the transient characteristics of a given system or on empirically determined and then tabulated coefficients. The control actions for both first and third stages are established by minimization of their composite target function under appropriate vectorial constraints. Solution of the corresponding system of differential and algebraic equations is possible, by numerical methods, but it is more expedient to split the problem into its two parts of dynamic stability and static stability--when the two controls are mutually independent or only weakly interdependent and, accordingly, the sum of their target functions is equal or approximately equal to the composite one. The control algorithms based on the solution to this perturbation problem and according to which the automatic protective hardware is to operate are best preformulated, on the basis of a multifactorial planned experiment, as polynomial functions of the controllable parameters. A facility for fault protection with automation at the individual plant level and with a microprocessor base has been developed according to these principles at the All-Union Institute of Electrical Engineering for hierarchical structurization of such a control system with parallel data processing. A comparative performance and cost analysis indicates that this facility is more reliable and economical than conventional facilities with centralized automation. Figures 1; references: 6 Russian.

[84-2415/5915]

UDC 621.313.333

TOPICAL PROBLEMS OF COMMUTATION OF DIRECT-CURRENT MACHINES OF LARGE AND  
MAXIMUM POWER

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIYA: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received 24 Apr 85) pp 26-35

BITYUTSKIY, I. B., candidate of technical sciences, assistant professor,  
Lipetskiy Polytechnical Institute

[Abstract] The problem of the commutation reliability of high-power direct-current machines is examined by means of a critical analysis of 40 publications covering the last 45 years. The lagging of the theory and practice of commutation behind technological requirements as well as the possibilities of computing and controlling techniques is recorded. It is concluded that: 1) The regulating possibilities of direct-current machines do not require an alternative for the time being, and in the visible future the principal features of their traditional use will be preserved; 2) The extent of commutation reliability does not correspond continuously with increasing requirements and remains the principal factor limiting the extent of use of direct-current machines of large power; 3) Methods of calculating commutation processes strongly lag behind the level attained by the development and software of electronic computers; 4) The development of microprocessor systems has not yet essentially affected control of commutation of direct-current machines; and 5) It is expedient to reevaluate the soundness of attempting to continually increase the commutated voltage of large power direct-current machines. Intensified use of computer technology is recommended for increasing reliability. Figures 1; references 40: 37 Russian, 3 Western.  
[109-6415/5915]

UDC 621.313.53

ELECTROMAGNETIC CHARACTERISTICS OF A LINEAR INDUCTION MOTOR WITH ROUGH WAVE  
IN LINEAR CURRENT LOAD

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received 24 Apr 85) pp 43-46

PETROV, V. F., graduate student, Novocherkassk Polytechnical Institute

[Abstract] Numerical investigations are made of the electromagnetic characteristics of a linear induction motor (LIM) with a rough wave in a linear current load, based on the two-dimensional model of the LIM, with the use of an algorithm worked out in a 1983 report by B. N. Siplivyy, V. F. Petrov, and Yu. K. Yermov, concerned with the electromagnetic field of force in a linear asynchronous motor. It is concluded that by a suitable choice of the value of the spatial displacement angle between the waves of primary current loads at neighboring pairs of poles of multipolar motors  $2p > 4$ , definite improvement is possible of such integrated characteristics as time averaging over an

interval of force acting on a conducting medium with  $Re \leq 9$ . In practice improvement in this case of the efficiency factor of the LIM does not succeed. Figures 3; references: 6 Russian.  
[109-6415/5915]

UDC 629.439

PROBLEMS OF CONSTRUCTION OF SYSTEMS OF CONTROL BY ELECTROMAGNETIC SUSPENSIONS ON A MICROELECTRONIC COMPUTER BASIS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received 12 Jun 84) pp 113-114

BAKHALOV, Yu. A., doctor of technical sciences, professor, Novocherkassk Polytechnical Institute; TUSHKANOV, N. B., candidate of technical sciences, assistant professor, Novocherkassk Polytechnical Institute; KONOVALOV, S. A., graduate student, Novocherkassk Polytechnical Institute; and NIKITENKO, Yu. A., candidate of technical sciences, Novocherkassk Polytechnical Institute

[Abstract] In recent years improvement of the quality of electromagnetic suspension was accomplished at the cost of complicating the control algorithms achieved within the framework of analog control systems. A further complication of these systems caused by the requirements of adaptiveness, multi-connection, and optimality with respect to various criteria of quality and high precision results in a significant decrease of their reliability. This factor in connection with the increasing possibilities of microprocessor technique leads to the urgent problem of studying the construction of regulators of the clearance of electromagnetic suspension on a microprocessor basis. Four concepts for construction of digital systems of automatic control of electromagnetic suspension are proposed by the authors. References 4: 2 Russian, 2 Western.  
[109-6415/5915]

UDC [621.335:625.2.012.858:538.65]:621.313.13.12

APPROXIMATION OF POWER CHARACTERISTICS OF ELECTRODYNAMIC SUSPENSION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received 30 Aug 84) pp 74-79

VYALTSEVA, T. M., graduate student, Novocherkassk Polytechnical Institute

[Abstract] The results are considered of an approximation of different functional dependences of levitation and deceleration forces as a function of the speed of motion and the height of suspension of the carrier solenoid for standard-production line systems of electrodynamic suspension with a continuous track structure, i.e., a finite bandwidth. Formulas are obtained which make it possible with various degrees of precision to approximate the above

items. The formulas may be used during investigation of the behavior of electrodynamic levitation systems in various regimes, with the goal of saving computer time and memory volume. Figures 3; references 6: 5 Russian, 1 Western (in Russian translation).

[109-6415/5915]

UDC 551.594.221

#### ESTIMATION OF PARAMETERS OF LIGHTNING DISCHARGE DURING DIRECT DESTRUCTION OF CONDUCTORS (CABLES)

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 10, Oct 85 pp 29-33

ALEKSANDROV, G. N., doctor of engineering sciences, professor, Leningrad Polytechnical Institute, and SOROKIN, A. F., candidate of technical sciences, Ivanovo Power Engineering Institute imeni V. I. Lenin

[Abstract] An analytical method is examined that can be used to find the lightning current when a power transmission conductor (cable) is struck. The method employed makes it possible to determine the propagation velocity of the neutralization wave, as well as the relationship between the current and time when the lightning strikes the ground. The wave impedance of the lightning channel is found to change during the neutralization process, and can be plotted as a V-shaped function of time. The calculated wave impedance is found to drop as the lightning current increases, reaching 240 ohms for  $I_m = 100$  kA. Figures 3, references: 5 Russian.

[113-6900/5915]

UDC 621.316.925

#### VALIDATION OF REQUIREMENTS AND SELECTION OF DESIGN FOR PROTECTION AGAINST SHORTING TO GROUND

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 10, Oct 85 pp 34-37

BUKHTOYAROV, V. F., candidate of technical sciences, assistant professor and POLYAKOV, V. Ye., doctor of engineering sciences, Ural Polytechnical Institute imeni. S. M. Kirov

[Abstract] The development of selective protection against single-phase shorts to ground in networks carrying 6-35V is addressed. The use of a panel of consultants to formulate specific protection requirements, and to select solutions that would best satisfy those requirements, is described. An analysis of the responses to a 20-item questionnaire indicates that the preferable principle depends upon the requirements that the protection measures

under development must satisfy. The most important requirements for the protection are identified. It is concluded that consultant assessments should be used as additional material to help the specialist to find the right solutions. Tables 2, references: 3 Russian.

[113-6900/5915]

UDC 621.311.1.016.025:621.316.722.0.013

#### USE OF AUTOMATICALLY ADJUSTABLE IRM THYRISTOR TO INCREASE RESULTANT STABILITY LEVEL OF LOAD CENTERS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 10, Oct 85 pp 38-39

RASSTRIGIN, A. K. and SVETLANOV-POLUPEZHENTSEV, A. V., engineers, Moscow Power Engineering Institute

[Abstract] This study describes investigations performed to determine the possibility of employing an IRM thyristor to regulate voltage in asynchronous modes in power systems. Experiments are described that indicate that the control system of the thyristor does not work properly when the voltage  $U_{min} < 0.4U_{nom}$ , so that the automatic regulation circuit of the thyristor is unstable in the immediate vicinity of the electrical center of oscillation. However, an automatically variable thyristor can be employed for voltages  $U > 0.4U_{nom}$  to increase the stability of the load centers in the asynchronous mode in power systems. Figures 3, references: 4 Russian.

[113-6900/5915]

UDC 621.311.1.003.13

#### ESTIMATION OF EFFECTIVENESS OF CAPITAL INVESTMENTS IN PLANNING DEVELOPMENT OF ELECTRICAL NETWORKS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 10, Oct 85 pp 113-117

SAMSONOV, V. S., candidate of economic sciences, All-Union Polytechnical Correspondence Institute

[Abstract] The problem of making capital investment more effective in planning the development of power networks is addressed. An approach is described in which the economic effectiveness of building each facility serving an electrical network is estimated, and that estimate is used as the basis for compiling a list of facilities to be built in the year in question considering existing conditions as well as all changes that have occurred in the power system but have not been reflected in the electrical network development plan. It is found that both the comparative and absolute effectiveness of capital investments must be calculated in the current planning stage, and that the absolute

effectiveness is best calculated by the criterion of profitability of new facilities for which a formula is derived. A condition is presented under which the results of calculations according to the profitability criterion and the calculated cost criterion will be the same. References: 4 Russian.  
[113-6900/5915]

UDC 621.316.31.001.2

#### RATIONAL PLACEMENT OF POWER DISTRIBUTING POINTS IN INDUSTRIAL ELECTRICAL POWER NETWORKS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY ENERGETIKA in Russian No 7,  
Jul 85 pp 13-16

ZHEZHELENKO, I. V., doctor of technical sciences, professor, Zhdanov Metallurgical Institute, and FEDOTOV, Ye. N., candidate of technical sciences, Kuybyshev Polytechnical Institute imeni V. V. Kuybyshev

[Abstract] This article presents a method for finding an effective placement for power distribution substations used in a radial power supply system for the case of uniform distribution of loads in an electric supply zone considering the area of economically equivalent solutions. Substations located near the head of the main power line should be closer to the route of the power line, possibly even outside the area to which electric power is supplied. Movement of substations along the path of the power line has much less influence on supply network costs than their movement off the power line, depends on the design of the main power line and should not exceed values obtained in radial supply of the substations. The method outlined in this article is therefore also applicable to a single main line power supply system. Figures 2, references: 1 Russian.

[26-6508/5915]

UDC 621.3.001.89

#### STATUS AND DEVELOPMENT OF POWER ENGINEERING AS A LARGE SYSTEM

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY ENERGETIKA in Russian No 7,  
Jul 85 pp 3-12

VENIKOV, V. A., laureate, Lenin and State Prizes, USSR distinguished scientist and engineer, RSFSR, laureate Yablochkov Prize, USSR Academy of Sciences, doctor of technical sciences, professor and chairman of electric engineering and power engineering sections, Scientific-Technical Council, Ministry of Higher Education, USSR

[Abstract] The power engineering situation is reviewed. The development of power engineering in the Soviet Union is based on the plan for electrification of Russia developed by Lenin. Power engineering must be studied in three

aspects, the technical aspect, the biosphere or ecologic aspect and the social-political aspect. A general diatribe against the US power industry, including its use to extract money from Latin America, its harm to the environment and its reluctance to follow the natural communistic route by nationalization, is followed by a rosy description of Soviet power engineering for the eighties. This paragon of international cooperation, with the largest unified system and now producing one third more power than the entire world produced in 1950, is stepping forward in the production of new power transmission lines, development and exploitation of new power and fuel resources ever further from populated areas and generous provision of power to the COMECON countries. Atomic plants will be emphasized and in 1981-85 already accounted for almost all capacity growth in the European part of the USSR.

[26-6508/5915]

UDC [64.06:621.3].004.18

#### INCREASE IN ECONOMY OF OPERATION OF DOMESTIC ELECTRIC APPLIANCES

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 9 Oct 84)  
pp 10-13

DOLGOVA, M. S., engineer, Informelektro

[Abstract] Increasing domestic power consumption requires increases in the economy of domestic electric appliances such as electric ranges, air conditioners and clothes dryers. Steps being taken to improve the efficiency of such high consumption items as electric ranges and heating units include design of more efficient heating elements and installation of infinite controls rather than four-position controls on electric ranges. Semiconductor light controls and the use of luminescent rather than incandescent light sources can reduce power consumption by 8 to 10 percent. References: 8 Russian.

[24-6508/5915]

UDC [628.94:628.973.1].002.2

#### MAJOR TRENDS IN DEVELOPMENT OF METHODS AND DEVICES FOR INTERIOR ILLUMINATION

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 2 Oct 84)  
pp 18-20

NOVOSELOV, Yu. Ye., engineer, SHAKHPARUNYANTS, G. R., UNDASYNOV, G. N.,  
candidates of technical sciences

[Abstract] The interrelationship of the complex, sometimes contradictory requirements of aesthetics, style and function in the design of the more than 3500 types of lamps and domestic light sources produced by 180 factories under various ministries and departments makes it particularly pressing to develop a single technical policy for the development of new methods of illumination of

residential interiors and the creation of the corresponding models of light sources. Studies performed at the All-Union Scientific Research, Planning-Design and Technological Institute of Light Engineering have established that the zonal method of illumination is more effective for a modern apartment. The essence of this method is that basic zones of activity are defined for existing apartment designs and furniture arrangements, and lighting is designed considering the nature of the visual work performed in each activity area. Light source designs are discussed and evaluated. It is noted that the appearance of new materials and technological processes, and the development of fashions and trends, with increasing consumer demand, require that institutes and industrial plants constantly develop new varieties of products of ever higher quality.

[24-6508/5915]

UDC [644.1:621.577].001.1

PROSPECTS FOR THE USE OF DOMESTIC ELECTRICAL APPLIANCES OPERATING ON THE PRINCIPLE OF A COMPRESSION HEAT PUMP

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 9 Oct 84)  
pp 27-29

AFANAS'YEVA, Ye. I., KRIVOV, L. L., candidates of technical sciences, Academy of Communal Economy imeni K. D. Pamfilov

[Abstract] There is a basically new method of utilizing electric power, the use of so-called heat pumps. Compression, absorption and thermoelectric type heat pumps have been developed, compression type being most suitable for the next few years at least. The operating principle of such a heat pump is briefly described. The most efficient source of heat for the outside coils of the heat pump is said to be the ground, although under typical conditions an area three to four times as large as the apartment being heated must be used to provide sufficient heat. Efficiency can be increased by supplying cooler air and cooler hot water with the heat pump, within permissible limits. Domestic heat pump designs should be developed for installation in the southern regions of the USSR alone and more research is required to evaluate the operation of various heat pump systems in other climatic zones. Figure 1.

[24-6508/5915]

STUDY AND DEVELOPMENT OF AIR-FILLED ELECTRIC RADIATORS

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 2 Oct 84)  
pp 36-38

AGAPOV, G. A., KLIONSKIY, V. Ya., engineers, KOSTYLEV, V. A., FILIPPOV, V. V.  
and SHAROVSKIY, A. V., candidates of technical sciences, All-Union Scientific  
Research Institute of Electric Equipment

[Abstract] Air at atmospheric pressure was used as the filling body in an electric radiator design, eliminating the need to seal the radiator body. The major problem in designing such radiators is that of providing uniform heating of the heat-liberating surface while using a relatively small heating element. The problem is aggravated in domestic electric heaters, in that surfaces which can be touched must not exceed a certain maximum temperature. When the air-filled radiator must produce specific heat outputs as high as those observed in oil-filled radiators, a system of shields is required to prevent excessive nonuniformity of surface temperature. Experimental designs of air-filled radiators with powers of 0.5 and 0.75 kW have been developed and series production is beginning at several enterprises. The new design saves money by not using the 3.5-4.5 kg/kW mineral oil required in oil-filled radiators, by decreasing production labor by 15 percent due to the reduced volume of welding operations and the absence of the operation of testing the seal of the body or pouring in the oil, lower mass and more rapid heating, and the ability to use nonimmersible electric heating elements. The expected annual savings is 6 to 7 rubles per kW of power capacity. Figures 2, references: 2 Russian.

[24-6508/5915]

CALCULATION OF UNCOMPENSATED EMF ON WOVEN PORTIONS OF CONDUCTORS TRANSPORTED 180° IN THE HEAD PORTION OF A STATOR WINDING ROD

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 10 May 84)  
pp 57-59

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[Abstract] In the head portions of stator winding rods in large turbine generators due to the complex nature of changes in the magnetic field, it is impossible to achieve practically identical emf in all conductors. Uncompensated emf appears between the conductors of the rod, leading to the appearance of balancing circulation currents closed through the heads of the rod. A study is made of an analytic method of determining the emf as a function of the initial position of the conductor in the rod at the exit from the core slot with magnetic induction applied along the transposed sector of the head portion of the rod, the vectors of the induction directed perpendicularly to

the broad face of the rod. The data obtained indicate that transposition of conductors by  $180^\circ$  in each head portion is effective only for stator winding rods with transposition of conductors by  $360^\circ$  in the slot portion. The twisting flange should be  $180/360/180$  in the same direction. Twisting of conductors in different directions as  $180/380/-180$  is not effective. The  $180/360/180$  scheme decreases losses from circulating currents caused by magnetic fields in this area by 8-9 times in comparison to the alternate  $0/360/0$  scheme. Transposition of conductors by  $180^\circ$  in each head portion with conductor twist in the slotted portion by  $540^\circ$ , as  $180/540/-180$ , is also ineffective, while  $180/540/180$  leads to an increase in losses due to circulating currents in comparison to the  $0/540/0$  scheme. Figures 4, references: 4 Russian.  
[24-6508/5915]

UDC 64.06-65.001.5

DOMESTIC ELECTRIC HEATING APPLIANCES. EXPERIENCE OF OPERATION OF HEAD ORGANIZATION

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 12 Oct 84)  
pp 16-18

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[Abstract] The total number of electric heating appliances has doubled in the past five years. Thirty-four million such devices were manufactured in 1984, and production is increasing steadily. There is no single center in the nation coordinating the development of the assortment of domestic electric heaters, meaning that the significance of head organizations responsible for the types of devices produced is increasing. This article discusses some aspects of the activity of such a head organization, including the conduct of scientific research work intended to increase the scientific-technical level of existing devices and design new ones, develop and introduce new devices, improve the technology of production, develop accessory products, test, standardize and study consumer properties and select the assortment of devices to be produced and study and form demand for the devices. Activity of a head organization in each of these areas is briefly described.

[24-6508/5915]

CAPACITIVE ELECTROMECHANICAL TRANSDUCERS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 6, Jun 85 (manuscript received 30 Jun 83) pp 92-99

CHELUKHIN, V. A.

[Abstract] Capacitive electric machines do not need massive metal conductors while the great internal resistance of the machines allows them to be used without preliminary transformers and the capacitance of such machines creates a capacitive load on the network thus increasing the power factor and decreasing the number of synchronous compensators required. The possibility of development of a theory of capacitive and inductive-capacitive electric machines by means of methods of the theory of dual inversion electrodynamics is studied. Results are presented from experimental investigation of models of capacitive electric motors. A photograph of an EKD-4 mk capacitive electric motor with air dielectric is presented. The technical characteristics of capacitive micromotors are almost equal to those of inductive microelectric motors, due to the use of a barium titanate ferroelectric dielectric material with great dielectric permeability and dielectric strength. The long series of studies and many failures required to develop the material emphasize the dependence of development of such motors on progress in the area of electric insulating materials and shows the need for research in the area of active materials for inductive-capacitive electric machines. Figures 4; references 9: 6 Russian, 3 Western.

[25-6508/5915]

STRUCTURAL AND ELECTRICAL PARAMETERS OF EXPERIMENTAL TRANSMISSION LINE BASED ON NEW COMPACT DESIGN

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 8-14

POSPELOV, G. Ye., doctor of technical sciences, professor, FEDIN, V. I., candidate of technical sciences, assistant professor, SELIVERSTOV, G. I., engineer, Belorussian Polytechnic Institute, KUTSENKO, G. F., candidate of technical sciences, Gomel Regional Power System Administration, and GOLOVACH, Yu. D., Gomel Polytechnic Institute

[Abstract] An experimental 1030 m long 0.38 kV 3-Ø electric transmission line was constructed jointly by the Gomel and Buda-Koshalev regional power system administrations according to a new design. Its characteristic feature is a compact delta layout in cross-section, attained by pairing each split phase of one circuit with a split phase of the other circuit on the same arm of the support structure so as to form square loops around each of the three delta corners with the conductors of the two paired split phases placed in alternate

corners of those squares 0.3 m apart. The supports are wooden poles with cross-arms: 27 of them spaced 40 m apart, except the first two spaced only 17 m apart. All conductors are solid, circular in cross-section with a 0.25 cm radius, so as to require the minimum number of individual connections made through insulated aluminum lead wires. The electrical parameters of this 2-circuit transmission line are measured by two procedures. Both open-circuit and short-circuit input impedances during steady-state excitation with the appropriate voltage and frequency and then the transient decay of oscillations are measured. For determination of the line resistance, inductance and capacitance, three measurements were made with the phases of both circuits pairwise in parallel and the conductor pairs carrying currents in phase (aiding), 60° out of phase (opposing), 120° out of phase (aiding), 180° out of phase (opposing), with six different configurations of phase conductors. The lowest row of conductors was 6 m above ground, allowing for an up to 1.7 m difference between support heights and for sag. The results of measurements have essentially confirmed the results of design calculations according to a special algorithm programmed for YeS computers and thus establish the feasibility of such a compact transmission line. It is particularly noteworthy that its electrical characteristics do not depend on the combination of pairing the split phases of the two circuits, when their currents are in phase opposition. Article was submitted by Department of Electrical Systems at Belorussian Polytechnic Institute. Figures 4; tables 3; references: 5 Russian.

[81-2415/5915]

UDC 621.311.1:621.319.001.5

#### COMBINATORIAL TUNED POWER FILTERS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 22-27

YATSENKO, A. A., candidate of technical sciences, assistant professor, Togliatti Polytechnic Institute

[Abstract] A comparative performance analysis of tuned power filters is made, such filters being used as effective means of ensuring a voltage waveform necessary for meeting GOST 13109-67 State Standard requirements with regard to indicators of electric energy consumed by nonlinear loads. Combinatorial single-frequency three-phase filters for use as individual devices or as components of compensators with stepwise regulation and of high-speed multi-functional power regulator-compensator equipment are of particular interest here. As criterion for comparison is selected the reduction of reactive power lost in the filter coils. Calculations are based on current-voltage relations according to Kirchoff's laws for filters with one inductive and two capacitive phases, three possible configurations being phase A, B, or C inductive with the other two capacitive. Calculations are also made for a short circuit in a capacitive phase C with either phase A or phase B also capacitive and the other one inductive. Article was submitted by Department of Electric Power Supply for Industrial Enterprises. Figures 2; references: 8 Russian.

[81-2415/5915]

## ANALOGY IN ELECTROMAGNETIC-FIELD PROBLEMS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 31-34

BARG, Ya. A., candidate of technical sciences, TOLKUNOV, V. P., doctor of technical sciences, and BARG, N. Ya., engineer, Ukrainian Polytechnic Correspondence Institute

[Abstract] An analogy is established between two physically different nonlinear problems. Calculation of the electromagnetic field generated by a ferromagnetic conductor with nonlinear magnetization characteristic is, according to this analogy, reduced to calculation of torsional stresses in a beam made of a nonlinear elastic material and thus to a problem with already known solution. The validity of this approach is proved on the basis of a system of two differential equations which describe the electromagnetic field of a ferromagnetic current-carrying conductor in a plane Cartesian system of coordinates, with the magnetization curve of the conductor material subdivided into  $k$  finite segments and each of them piecewise-analytically approximated with a quadratic binomial. The condition for equivalence of the field problem and the stress problem is that  $1/4d_i j^2 = g_2 \omega^2$  ( $d_i$  - coefficients of quadratic terms in binomial approximation,  $j$  - current density in conductor,  $g_2$  - coefficient characterizing the nonlinearity of the elastic beam material,  $\omega$  - twist angle of beam). As an illustrative example is considered a rectangular ferromagnetic bar carrying a current uniformly distributed over its cross-section. Article was submitted by Department of Electrical Machines and Apparatus. References 5: 2 Russian, 3 Western (all in Russian translation).

[81-2415/5915]

## MATHEMATICAL FORMULATION OF MEASUREMENT PROBLEM FOR SOME PARAMETERS OF ELECTROSTATIC FIELD

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85, pp 34-37

KORNIYENKO, P. M., candidate of technical sciences, assistant professor, and OGANEZOV, A. N., candidate of technical sciences, assistant professor, Belorussian Polytechnic Institute

[Abstract] The problem of measuring the electric field potential at some point above or below a charged plate is formulated mathematically for an electrometer consisting of two parallel plates under a direct voltage. While the physical model is determined by the capacitor geometry, the mathematical model represents the Dirichlet problem with a double Green integral describing the voltage distribution. A symmetric uniform electric field reduces the three-dimensional problem in a cylindrical system of coordinates to a two-dimensional

one in a polar system of coordinates in the plane of one plate assumed to be at zero potential. The double integral then reduces to a single elliptic one with respect to the angular coordinate, expressible in terms of theta functions. This formulation of the problem is illustrated on two parallel disks and is extended to coaxial cylinders one inside the other. Article was submitted by Department of General Electrical Engineering. Figures 3; references: 3 Russian. [81-2415/5915]

UDC 621.314.2:536.1

#### THERMAL REGIME IN TRANSFORMER WITH HIGH MAGNETIC INDUCTION IN IRON STRUCTURE

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 43-45

YESHEL'KIN, V. M., candidate of technical sciences, assistant professor, Ivanovo Institute of Power Engineering imeni V. I. Lenin, ZAYTSEV, S. G., engineer, Leningrad Polytechnic Institute imeni M. I. Kalinin, and LYSOV, Yu. A., engineer, Leningrad Regional Power System Administration

[Abstract] For determination of the thermal operating regime in power transformers and its dependence on the magnetic induction in the iron structure, measurements were made at three levels of magnetic induction in the high range (1.5, 1.7, 1.9 T) with the primary winding of a 3-winding transformer connected to a source of variable alternating voltage and the other two windings carrying direct current at constant nominal level. The temperature field in the various iron components was determined at each level of magnetic induction, whereupon the dependence of iron and copper temperatures on the core losses was established. Transformer reliability and life can be estimated on the basis of such data with the aid of an analytical model and an appropriate computer program, assuming that the copper losses raise only the temperature of windings and are not significant sources of iron heating, that the iron structure is isotropic with a uniform distribution of heat sources and that temperature drops across the thickness of iron components are negligible. An empirical formula according to D. I. Petrovskiy for the coefficients of heat transfer at the surfaces of the various iron components in the transformer structure is

$$\text{suitable here, namely } \alpha = \frac{846 - 5560/(0.66 + 10\Delta_d)}{57.5 + h - 276/(10\Delta_d - 2.45)} \quad (\Delta_d - 0.01 - 0.04 \text{ m} - \text{duct width}, h = 0.05 - 0.6 \text{ m} - \text{duct height}, A = 0.98 - 1.0 \text{ for ducts within this range of widths}). \text{ Figures 3; references: 2 Russian.}$$

[81-2415/5915]

## NEW METHODS FOR CALCULATING PROPERTIES OF LIQUID-METAL COOLANTS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 66-71

FILIPPOV, L. P., doctor of physico-mathematical sciences, and BLAGONRAOV, L.A., candidate of physico-mathematical sciences, Moscow State University imeni M. V. Lomonosov

[Abstract] Several properties of liquid metals at high temperatures and under high pressures have been calculated according to procedures analogous to those now applied to liquid dielectrics and according to analogously semiempirical relations with the aid of experimental data. The formula for density  $\rho_s$  on the saturation line is analogous to that for the density of dielectric liquids within the range from triple point  $T_3$  to critical point  $T_c$ , namely

$$(\rho - \rho_c)/\rho_c = B\nu^\beta + (B - 1)\nu^2. \text{ Here } \nu = (T - T_c)/(T_c), \beta = 1/2 \text{ (not 0.323 as for dielectric liquids), and } B = 0.505RT_c/P_c V_c.$$

(R - universal gas constant,

$P_c$ ,  $V_c$  - pressure and volume at critical point  $T_c$ ). The ratio of pressure at temperature  $T$  to pressure at the critical point in the vicinity of the latter

$$(v < 0.5) \text{ is } P/P_c = f(T/T_c) = 1 - v^2/[1 + (B - 1)v^2]^{1/\beta}. \text{ The P-V-T relation is}$$

$$(P - P_s)/P_c = C(\rho - \rho_c)/\rho_c \text{ with } C \approx 1 \text{ and including the "classical" isotherm}$$

$$P/P_c \sim [(\rho - \rho_c)/\rho_c]^3. \text{ Isothermal compressibility is } k_T = \rho_c^3/3P_c(\rho - \rho_c)^2\rho.$$

These formulas have been applied to liquid alkali metals, cesium being a representative one, and found to be accurate within limits specified in the 1983 information sheets on thermophysical properties of substances. Article was submitted by Department of Molecular Physics. Figures 2; tables 3; references 7: 6 Russian, 1 Western.

[81-2415/5915]

## USE OF AVALANCHE DISCHARGE MECHANISM FOR DETERMINING ELECTRICAL STRENGTH OF INSULATION IN OIL-FILLED ELECTRICAL APPARATUS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 28-31

STEPANCHUK, K. F., candidate of technical sciences, assistant professor, Belorussian Polytechnic Institute, ANTONOV, G. I., engineer, and DOLYUK, R. P., candidate of technical sciences, All-Union Institute of Transformer Construction

[Abstract] In an earlier study (ENERGETIKA No 8, 1985) the authors have developed a theory of avalanche discharge for predicting, on the basis of only

a few tests, the electrical strength of composite-material insulation in electrical apparatus such as power transformers and cables under short impact loads. This theory applies also to a paper-oil gap between conductors or coils at different potentials, such a gap also constituting an essentially multi-layer insulation system. The relation for the electric breakdown field intensity must be modified appropriately, to fit the physical structure and the correspondingly not quite uniform electric field distribution. With numerical values based on tests of 1 minute duration with 50 Hz voltage, given thickness S of the oil layer, and known dielectric permittivity of oil, this relation reduces to  $E_S = 45(\frac{0.16}{S})^{1/3}$  kV/mm accurately within 3% for

S = 0.08-0.36 mm. This formula, in turn, serves as basis for calculation of the breakdown voltage and design the paper wrap. Article was submitted by Department of High-Voltage Engineering at Belorussian Polytechnic Institute. Figures 1; tables 2; references: 6 Russian.

[81-2415/5915]

UDC 537.523.5.001.5

#### PARELECTRODE REGIONS OF FREE GLOW-DISCHARGE ARC IN AIR

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 9, Sep 85 pp 45-47

ABRAMOV, N. R., engineer, Moscow Institute of Power Engineering

[Abstract] Lightning strokes were simulated in an experimental study for gathering data more reliable than available ones on the dimensions of the base zones and thus also the current density at the surfaces of both electrodes in air. As current generator served a 17  $\mu$ F - 5 kV capacitor bank, with an adjustable resistor in the discharge circuit for current regulation. Aperiodic discharges with time constants not exceeding 0.5 s much were produced between two aluminum disks with round edges serving as electrodes, spaced 20 cm apart so as to eliminate the effects caused at each by counterflow of plasma and erosion products from the other one. Discharges were triggered by burst of a current-carrying wire 0.18 mm in diameter. Measurements were made with the aid of an oscilloscope and high-speed photography. Both revealed a base zone initially 5.2 mm in diameter with glowing hot metal at the highest level of arc current, its diameter decreasing with decrease of the current. An essentially similar pattern of changes was noted at the cathode with a single erosion track and at the anode with several symmetrically spaced erosion tracks, this difference being a consequence of arc pinning at the cathode surface and arc jumping over the anode surface. A further evaluation of the data has revealed that the current density in each base zone remains constant during discharge periods of up to 0.5 s and does not depend on the current over the 50-450 A range. This density was found to be different at

the two electrodes,  $17.5 \text{ A/mm}^2$  at the aluminum cathode and  $24.0 \text{ A/mm}^2$  at the aluminum anode with the current at its maximum level. Figures 3; references 2: 1 Russian, 1 Western (in Russian translation).

[81-2415/5915]

THE OCEANIC SALINITY GRADIENT AS AN ENERGY SOURCE

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 85, pp 3-8

AKULICHEV, V. A., doctor of physical-mathematical sciences, KNYAZHEV, V. V., candidate of technical sciences, ILIN, A. K., engineer, and LISITSA, V. D., Pacific Institute of Oceanography

[Abstract] The salinity gradient in the ocean, greatest in areas where fresh water rivers enter the ocean, represents a potential power source equal to the theoretical hydropower resources of the earth. It represents a greater specific energy density than tidal, wave, current or wind power sources in the ocean, being second only to thermal (based on temperature variation with depth). An equation is presented for estimation of the total power resources available in salinity gradients. Various methods can be implemented to realize the potential power, including hydroosmotic, inverse electrolysis, adiabatic expansion of vapor, electrochemical, mechanicochemical and freezing methods. A table lists these methods, the energy conversion principles upon which they are based, basic equipment required, capital investments per kilowatt and specific costs of electric power, all costs expressed in dollars and cents. It is noted that some salinity-gradient-based energy power sources have virtually zero ecological effect. Figures 3, references 6: 3 Russian, 3 Western.

[62-6508/5915]

OPTIMIZATION OF USAGE SCHEMES FOR ELECTRIC POWER DISTRIBUTION NETWORKS WITH RESPECT TO ENERGY LOSSES BY THE GRADIENT METHOD

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 85 pp 9-11

BULATOV, B. G. and USHAKOV, I. M., candidates of technical sciences, assistant professors, and FOMIN, N. I., engineer, Chelyabinsk Polytechnical Institute imeni Lenin Komsomol.

[Abstract] An algorithm has been developed for optimization of connection points in distribution networks based on the criterion of minimum power loss under maximum load conditions. However, actual distribution networks frequently do not achieve maximum loss reduction by the use of this scheme. Optimization of a distribution network is studied as a problem of seeking disconnection points such that the total power losses over a given period of time are minimal, considering the entire profile of varying loads on the network. A program to solve the problem by the gradient projection method has been written in FORTRAN-4 and used to optimized 6-10 kV power lines for the cities of Izhevsk and Chelyabinsk. Figure 1, references: 5 Russian.

[62-6508/5915]

UDC 621.332:621.316

EFFECTIVE COMPENSATION OF REACTIVE POWER ON ELECTRIC RAIL LINES  
CONSIDERING FIXED COSTS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian, No 8,  
Aug 85 pp 12-16

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Gorkiy Branch, All-Union Correspondence Institute of Railroad Transport  
Engineering

[Abstract] A method of calculating the optimal reactive power compensation for three-phase networks with balanced loads has been developed, and can be used to design three-phase networks with unbalanced traction loads as well. The goal function of adjusted costs related to compensation to reactive power can be expressed in a form suitable for this calculation. A new method is suggested for considering the fixed costs in such problems, distinguished by clarity of computation, since it is based on direct comparison of adjusted costs for various versions of placement of compensating equipment. The iterative solution method begins by assuming placement of transverse capacitive compensation installations in all loaded sectors, then gradually, reduces the number of such devices in each subsequent iteration, seeking the minimum cost, including fixed costs. Selection of the estimate for limitation of branching of versions considered is described and means are noted for increasing the sensitivity of the method. Figure 1; references: 3 Russian.  
[62-6508/5915]

UDC 621.318.2

EFFECTIVENESS OF TRANSFER OF MECHANICAL ENERGY INTO SEALED SPACES BY MEANS  
OF MAGNETIC COUPLING

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8,  
Aug 85 pp 32-36

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[Abstract] In planning magnetic couplings for transfer of mechanical energy into sealed chemical systems, the major problem is selection of the number of magnets and their placement around the cylindrical surfaces of the coupling units to achieve maximum torque with minimum mass and size. The thermal losses resulting from eddy currents and mechanical losses must also be calculated. An algorithm is presented for solution of this complex set of problems in a form convenient for computer programming and computation. The algorithm allows, by varying design dimensions, a search for optimal relationships in order to maximize transmitted power. An example is presented of design of a coupling with 98.4% power transmission efficiency. Figures 3, references:  
7 Russian.  
[62-6508/5915]

PROSPECTS AND PROBLEMS OF INCREASING THERMAL ELECTRIC POWER PLANT  
MANEUVERABILITY

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8,  
Aug 85 pp 53-57

LEONKOV, A. M., professor, GERASIMOV, V. V., engineer, KUSKOV, I. A.,  
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Belorussian Polytechnical Institute; Lukomlskaya Regional Electric Power  
Plant, Yuzhtekhnenergo

[Abstract] Special studies by the authors' organizations have revealed the possibility in principle of long-term operation of fossil-fuel boilers in power plants at loads of 30% of the nominal while maintaining supercritical pressure in the evaporator and variable pressure in the superheaters. However, a number of problems related to boiler control, regulation of forced draft mechanisms, water, fuel and air consumption and the reliability of downstream turbine stages remain unsolved. Increasing the nominal capacity of supercritical pressure power units is the most realistic means for increasing the generating capacity of power systems while expanding the range of regulation capability of thermal electric power plants. This method requires a variety of solutions intended to improve economy and reliability of thermal power equipment. Some specific steps which must be taken and problems which must be solved to implement the method are noted. They include increasing the number of nozzles in the K-300-240 turbine used in 300 MW power units from 56 to 64 to increase the maximum throughput capacity of the turbine and verification of the reliability of the unit under the new conditions. The steps called for will further expand the range of regulation of 300-1200 MW power units. Increasing the generating capacity of power systems without additional significant capital investments. References: 5 Russian.

[62-6508/5915]

PRINCIPLES OF EXTERNAL PLANNING OF COMBINED ELECTROCHEMICAL POWER  
INSTALLATIONS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8,  
Aug 85 pp 57-63

NESTEROV, B. P., doctor of technical sciences, GRIGORYEV, V. F. and  
YEFIMTSEV, S. I., engineers and GRACHEV, A. B., candidate of technical  
sciences, Moscow Institute of Power Engineering

[Abstract] External planning, or macroplanning, of electrochemical combined power installations includes their thermodynamic analysis as a portion of the systems analysis and creation of a modeling algorithm. Until recently, planning of combined electrochemical installations has been based on the

experience and intuition of the planners, who must select an acceptable version from among a small number of alternative solutions. This article suggests a method of thermodynamic analysis and mathematical modeling of such systems. The use of the principles of external planning is analyzed on the example of a hydrogen-oxygen electrochemical system consisting of an electrolyzer plus electrochemical generator and a system for storage of reagents in liquid form. In order to achieve the maximum specific output of the unit, it must be planned for maximum current density. With a ratio of time of storage to time of generation of energy of about 3:1, electrolyzers must be planned with a maximum area of electrodes at minimum pressure and moderate temperature, while the electrochemical generators must be planned for operation at elevated temperatures. Energy is selected as the operational unit for analysis and macro-planning of the combined electrochemical power unit, since it allows consideration of various interconnections, subdividing the unit into components for analysis and planning and creating effectiveness criteria which are quantitative. Figures 3, references: 5 Russian.

[62-6508/5915]

UDC 532.51:533.601.1

#### PREVENTING BOUNDARY LAYER SEPARATION

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 85 pp 69-74

ZARYANKIN, A. Ye., doctor of technical sciences, professor, Moscow Institute of Power Engineering

[Abstract] The author analyzes how velocity profiles within the boundary layer in a confusor-diffusor channel change, as well as the change in the forces of friction, based on a statement in the later works of Prandtl that under these conditions the forces of friction tend to prevent rather than cause boundary layer separation. The velocity profile in the boundary layer of the diffusor channel is found to be quite complex. An equation is derived which reflects the force factors at the point of flow separation. Flow separation is the natural reaction to excessive external effects which cannot be overcome by internal forces. Figures 3, references: 6 Russian.

[62-6508/5915]

QUANTUM ELECTRONICS, ELECTRO-OPTICS

UDC 536.52

CALCULATION OF BASIC PARAMETERS OF THERMAL DETECTOR WITH OPTICAL COMMUNICATIONS CHANNEL

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 18 Dec 84) pp 13-14

BRATASYUK, N. M. and SHIMON, N. Yu.

[Abstract] The basic parameters are calculated for a thermal detector with an optical communications channel in which the active element that senses the heat flux and changes its thermal state is a dielectric plate whose index of refraction depends upon temperature. The integral sensitivity and threshold flux of a detector incorporating a Ge-As-Se active element and an FD-4 photodiode are calculated. The sensitivity of the thermal detector employing an optical channel is found to be two orders of magnitude smaller than that of photon detectors. The component of the electrical noise at the output of the electron amplifier caused by temperature fluctuations of the active element is found to be far smaller than the intrinsic noise of the photon detector. The threshold flux value, which is restricted by temperature fluctuations, is found to be characteristic for ideal thermal detectors operating in the radiation heat exchange mode. Figures 1; references 6: 4 Russian, 2 Western.  
[111-6900/5915]

UDC 621.383.8:621.385

INVESTIGATION OF RESIDUAL GASEOUS MEDIUM AND ESTIMATION OF LEVEL OF MULTIELECTRON SCINTILLATIONS IN ELECTRON-OPTICAL CONVERTER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 20 Mar 85) pp 20-23

ARKHIPOVA, T. A., BELOSHEYEV, V. K., YERZUNOV, A. I., KUPTSOVA, G. Z.,  
PAKHOMOV, M. T., POTAPOV, A. M. and SMIRNOVA, M. I.

[Abstract] The change in the composition of the residual gaseous medium in optoelectronic converters with and without titanium strip gas absorbers, as well as the changes for different levels of illumination, are investigated using an IPDO-2A partial pressure meter with an RMO-4S sensor. The titanium gas absorber consists of a V-shaped strip of titanium that is secured to the inputs of the cylindrical blade. Noise was measured by scintillation counting.

The results indicate that the use of the titanium gas absorber provides a residual pressure level from three to five times lower than without the absorber, and also restructures the residual gas through significantly reduced partial pressures of such gas components as CO, H<sub>2</sub>O, H<sub>2</sub> and CH<sub>4</sub>. The initial level of multielectron scintillations is also lower in optoelectronic converters employing the titanium gas absorbers. The findings indicate that magnetic discharge pumps, as well as titanium gas absorbers, make it possible to reduce the background scintillations by factors ranging from 10 to 100. Figures 3; tables 2; references 9: 6 Russian, 3 Western.  
[111-6900/5915]

UDC 535.824

#### MINIATURE SPECTROPHOTOMETRIC DEVICE WITH LIGHT-EMITTING DIODE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 21 Jan 85) pp 32-33

KOSYACHYENKO, L. A., RUBITEL, V. V., SOLONCHUK, I. V., SHEMYAKIN, V. A.  
and YAMBORAK, V. S.

[Abstract] A spectrophotometer developed by the authors is described that is capable of measurements over a broad spectral range at ambient temperatures reaching from 0 to +40 degrees C with 0.01...0.03 μm spectral resolution. A reverse-biased light emitting diode is employed as the radiation source. Monochromatic flux is extracted from the broad radiation spectrum of the LED by means of a set of interference light filters prepared by vacuum deposition of multilayer dielectric films. The temporal instability of the output response of the device does not exceed 3 percent over 8 hours of continuous operation. Measurements indicate that the entire measurement circuit is sufficiently linear. The combined optical density measurement error was found experimentally to be smaller than 1 percent for the entire spectral range. Figures 3, references: 4 Russian.  
[111-6900/5915]

UDC 549.517.13:535.36

#### MEASUREMENT OF INDICES OF DIRECTIONAL SCATTERING IN OPTICAL GLASSES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 27 Dec 84) pp 40-41

KARPOV, A. V., KOLYADIN, A. I., KRAVCHENKO, A. V. and MUKHINA, T. I.

[Abstract] A simple method is described for measuring indices of directional scattering in optical glasses employed in fiberoptic lines with extremely low absorption. The experimental setup used to measure 90-degree scattering is based on an NFS nephelometer that outputs to an electronic recording device

consisting of a photomultiplier, an AC amplifier, a synchronous detector, and a null indicator. The use of the system to measure the directional scattering indices of a number of brands of optical glasses at the wavelengths of helium-neon and helium-cadmium lasers is described, and the measurement results are tabulated. The relative error in determining the scattering index did not exceed 5 percent. Figure 1; tables 1, references: 6 Russian.  
[111-6900/5915]

UDC 535.8

#### POLARIZATION OPTOELECTRONIC ANGLE METERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 15 Mar 85) pp 51-57

KOROTAYEV, V. V. and PANKOV, E. D.

[Abstract] Optoelectronic angle measuring devices that exploit the properties of polarized radiation are reviewed. These devices have the advantage that the information about the measured angles is contained in the polarization state of the radiation, making it possible to develop devices with smaller diameter light channels than other types of angle meters. The systems examined are grouped by modulation methods: oscillation of the azimuth of linear polarized radiation, oscillation of the phase difference between the radiation components, rotation of the azimuth of polarized radiation, and modulation of signals taken from a system of photodetectors. A comparative assessment is made of circuit parameters including sensitivity, accuracy, and complexity. The development of polarization angle measuring devices is found to be moving in the direction of expanding the range of measurable angles, reducing measurement error, providing a wide range of distances between objects, and finding fundamentally new approaches and components. Figures 10, references 46: 30 Russian, 16 Western.

[111-6900/5915]

UDC 539.3

#### STRUCTURAL STRENGTH OF OPTICAL PORT

Leningrad OPTIKO MEKHANICHESKAYA PROMYSHLENNOST in Russian No 10, Oct 85  
(manuscript received 19 Jan 84) pp 58-61

DYACHKOV, I. I. and KOMYAGIN, Yu. V.

[Abstract] The structural strength of a self-contained disk-type optical port made of K8 and KV glass for use in hydrooptical devices operating in the visible part of the spectrum is analyzed. The bearing strength, operability, and service life of the device is investigated. The stress-strain state of the optical assembly is investigated by solving an axisymmetrical mixed problem of the linear theory of elasticity. The findings indicate that the device can be recommended for widespread use in hydrooptical instruments. Figures 3; references: 5 Russian.

[111-6900/5915]

UDC 621.378.001

QUASI-OPTIMUM RECEPTION OF OPTICAL SIGNALS WITH AMPLITUDE MODULATION OF CARRIER IN OPTICAL SUPERHETERODYNE RECEIVER

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 4 Mar 85) pp 62-65

DOBROLYUBOVA, L. G., DOLZHENKOV, V. A. and KOBZEV, V. V.

[Abstract] An optical superheterodyne receiver of amplitude-modulation signals with phase-lock automatic frequency control is considered which includes phase correction inside the reference beam for maximizing the efficiency of input signal conversion and a filter for completing the control loop. The random parameter of amplitude modulation, dependent on the phase of the control signal, is estimated by applying the method of maximum a posteriori probability to the optical field generated at the photodetector output in the form of an interference pattern. Superposition of two oscillations in the photodetector, namely of the input signal and of the optical reference-heterodyne signal, produces a photodetector output signal which is an additive mixture of a signal and a Gaussian white noise  $y(t) = S(t,x) + n(t)$ . The problem of parameter estimation and subsequent signal filtration reduces to a system of two a priori stochastic second-order differential equations in  $x$  and  $y$  which includes two quasi-noncorrelated stationary white noises. A quasi-optimum filter is then synthesized with the aid of the fundamental Stratonovich equation, which the optimum quasi-linear control system will simulate. Figures 3; references 8: 6 Russian, 2 Western (in Russian translation).

[80-2415/5915]

UDC 621.391.278

INTERFERENCE IMMUNITY OF OPTIMUM DEMODULATOR OF DIGITAL OPTICAL SIGNALS WITH INTERSYMBOL DISTORTIONS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 10 Dec 84) pp 65-67

ZELIGER, A. N. and NITER, B.

[Abstract] The optimum demodulator is constructed for digital optical signals with intersymbol distortions. The problem of signal identification within the processing period  $T$  is transformed to the problem of signal identification within a period  $(2r + 1)T$ , where  $r \gg x$  is a whole number and this period corresponds to transmission of a code sequence containing  $2r + 1$  elements.

One half of the  $2^{2r}$  possible code sequences contains "0" as the center element and constitutes set  $S_I$  of sequences, while the other half contains "1" as the center element and constitutes set  $S_{II}$  of sequences. Processing the demodulator input signal over a time period  $(2r + 1)T$  for its identification and an

$S_I$  or  $S_{II}$  sequence is preferable because, as  $r$  increases, the demodulator becomes increasingly insensitive to intersymbol distortions. The interference immunity of the optimum demodulator operating according to this algorithm with a photo-detector characterized by zero internal amplification and a Poisson probability distribution of electron production is estimated in terms of the error probability as a function of the mean number of photons per signal element, assuming that  $r$  is sufficiently large for disregarding any overlap of signals and for safely accepting the possibility of  $2^{r+1}$  signal variants appearing at the receiver input. Figures 1.  
[80-2415/5915]

UDC 621.375:535.42

#### DYNAMIC RANGE OF ACOUSTOOPTIC LIGHT MODULATOR

Moscow RADIOTEKHNIKA in Russian No 8, Aug 85  
(manuscript received after revision 14 Feb 85) pp 70-72

VASILYEV, Yu. G.

[Abstract] Two important design parameters of an acoustooptic light modulator, its dynamic range and the acoustic power necessary for ensuring a sufficiently wide one within the operating frequency range equal to double the frequency deviation, are evaluated by the two-signal method. The dynamic range as a function of the background light intensity is calculated from measurement of the diffraction efficiency in the first diffraction order with a radio-frequency signal at the modulator input. Measurements made separately in the Raman-Nata diffraction mode and the Bragg diffraction mode yield correspondingly two dynamic ranges, both with a relative error not larger than 2-3% under usual conditions with not more than 100% phase modulation of the light. Subsequent calculation of the acoustic power in both cases reveals that, while a Bragg modulator has 3-4 dB wider dynamic range than a Raman-Nata modulator, it requires much less acoustic power for ensuring a wide one. References 10:  
5 Russian, 5 Western (2 in Russian translation).  
[80-2415/5915]

UDC 531.715.2(088.8)

#### REFRACTION CONTROL OF CAPILLARIES AND MATCHING ELEMENTS OF FIBER-OPTIC COMMUNICATIONS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian No 9, Sep 85 (manuscript received 6 Dec 84) pp 58-65

LAZAREV, L. P. and MIROVITSKAYA, S. D., Moscow Institute of Radio Engineering, Electronics, and Automatics

[Abstract] Analytical relationships are obtained for the problem of determining the optical-geometrical parameters of various multilayer optical elements.

A formula is derived for determining the diffraction angle of the beam of a gradient core, as well as a general formula for determining the diffraction of the beam of a fiber element with a multilayer shell. The paper was recommended by the Department of Electronics and Automation. Figures 3; references 4: 1 Russian, 3 Western.  
[90-6415/5915]

UDC 681.785.423.3:535.342

#### ERRORS IN IR SPECTROPHOTOMETERS RESULTING FROM MULTIPLE REFLECTIONS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 26 Nov 84) pp 6-8

VOROBIEV, V. G., GONCHAR, T. G. and KRUGLYAKOVA, M. A.

[Abstract] It has been assumed that IR spectrophotometers with mirror optics do not have errors resulting from multiple reflections between the specimen and elements of the optical system. However, the authors have found such errors, resulting either from multiple reflections between the surface of the specimen and some elements in the optical system, or possible defocusing resulting from an increase in the optical path length when a specimen of a certain index of refraction and thickness is present. A study is made to distinguish the influence of these two possible causes of the errors. Measurements of plane-parallel plates of BaF<sub>2</sub> and type IKS29 glass indicate that with the standard position of the specimen the transmission factor differs from the true value by 1 to 2% for the barium fluoride and 2.5-7% for the glass. It is suggested that the blades of the input slit of the monochromator be placed at an angle to the beam axis, perhaps perpendicular to the outer rays, in order to eliminate the error resulting from multiple reflections. For instruments with a relative aperture of 1:6, the angle should be at least 5°s.  
Figures 4; references 5: 3 Russian, 2 Western.  
[69-6508/5915]

UDC 519.24

#### FALSE ALARMS IN A MULTIVARIATE SPACE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 1 Nov 83) pp 1-2

SHKURSKIY, B. I.

[Abstract] A previous work presented expressions to estimate the spatial density of false alarms assuming that noise is a random function of two arguments. The purpose of this article was to produce similar expressions for functions of three and four arguments. All expressions for estimation of the

spatial density of false alarms obtained are approximate, beginning with the case of two arguments. For three or more arguments of a random function there are no closed areas of false alarms. The equations derived allow an expression to be written to compute the spatial density of false alarms for the case of n arguments. Reference: 1 Russian.

[69-6508/5915]

UDC 621.384.31

#### INFLUENCE OF OPTICAL-ELECTRONIC INSTRUMENT PARAMETERS ON SCANNING RATE OF A SPACE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 27 Dec 84) pp 10-13

ZDOR, S. Ye. and CHERNOV, V. S.

[Abstract] The effectiveness of performance of a search task is determined by the range of an instrument, probability of proper detection, number of false alarms, error in estimation of coordinates of detected objects and the scanning rate of the space to be observed. The scanning rate should be maximized in the process of designing a search instrument. The presence of rapidly moving objects in the field observed places great demands on scanning rate. When searching for nonmoving objects, the dimensions and shape of the field of vision have practically no influence on scanning rate. Figures 3; references: 6 Russian.

[69-6508/5915]

UDC 535.417

#### USE OF PHASE-SHIFTING LAYER TO EXPAND THE SPECTRAL AREA OF INTERFERENCE MIRRORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 27 Jun 84) pp 13-16

XHIGLINSKIY, A. G., KUCHINSKIY, V. V., MILOVANOV, N. P. and PARCHEVSKIY, S. G.

[Abstract] A study is made of the possibility of further increasing the spectral area of reflection of wideband mirrors, expanding the range of their reflection coefficients and the use of such mirrors. The method suggested for the creation of wideband mirrors is that a layer of variable optical thickness is placed between two interference mirrors, changing the phase shift between the interference waves reflected from the two mirrors from point to point on the surface of the mirror. The mirrors between which this phase-shifting layer is placed may be either quarter wave narrow band or variable-thickness wideband reflectors. The mirrors can be used as reflectors in dye-based laser resonators. Figures 3; references 9: 7 Russian, 2 Western.

[69-6508/5915]

UDC 535.681.41

INSTALLATION FOR ESTIMATION OF CLARITY OF FIELD OF VISION OF FIBER OPTIC LINES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 17 Dec 84) pp 29-30

VESNICHEV, V. A., GUZHEVSKAYA, A. V., VASIN, L. N., LEYKIN, M. V.,  
KORTUSOVA, Ye. B. and NAZAROV, B. N.

[Abstract] The major defects reducing the optical clarity of fiber optic lines include broken fibers and fibers with decreased light transmission, as well as inclusions between the fibers and gaps between fibers greater than half the diameter of an individual fiber. Quality assurance of fiber optic cords is necessary both in the design stage and during manufacture. An apparatus has now been developed to eliminate the subjectivism and error of the previous quality assurance method, i.e., counting of defects by visual observation with a microscope. The device consists of an apparatus for photography of the ends of cords, a contact printer and a projection device with a photometer-counter. A photograph and a diagram of the device are presented, as well as a photograph of the end of a fiber optic cord showing typical defects. The device allows areas of varying light intensity to be counted where light intensity varies by not over 5%. The device has completed laboratory testing and is now in use in industry. Figures 2; reference: 1 Russian.

[69-6508/5915]

UDC 681.7:658.5201.56

OPTIMIZATION OF TECHNOLOGICAL PROCESS OF AUTOMATED PROCESSING OF HIGH PRECISION LARGE OPTICAL PARTS WITH SMALL TOOLS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 14 Feb 84) pp 32-36

BOGDANOV, A. P.

[Abstract] A study is made of the process of automated finishing of the surfaces of large high precision optical parts with small tools and ion beams. The surface of the part and the tool are divided into elementary unit areas and each area is represented by a point which is assigned a number. Equations are derived for determination of the proper tool movement trajectory to advance the shape of the surface in the desired direction. The nonuniformity of distribution of contact pressure over the various points on the surface of the part as the tool moves over the part is considered. The method has achieved accuracy of surfaces characterized by a surface quality index of  $0.033 \mu\text{m}$ , superior to that achieved by the Zebra-3 system. Automated processing does not achieve a decrease in the mean dimensions of local errors, but does improve the distribution of energy over the scattering circle. Figures 3; references 12: 9 Russian, 3 Western.

[69-6508/5915]

UDC 621.923.7:681.7.05

' TENSIFICATION OF PROCESS OF POLISHING SPHERICAL OPTICAL PARTS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 1 Aug 84) pp 37-39

OZEROV, K. P., MALANIN, A. D., SONIN, V. A., ZATSEPIN, V. S. and GRACHEV, A. I.

[Abstract] A study is made of the possibility of intensifying the process of polishing by control of relative speeds at contact points between tool and part assuming otherwise equivalent conditions during processing of spherical optical surfaces. A graphic method is used to construct a three-dimensional surface illustrating the distribution of relative velocities over the entire spherical surface being worked. There is an optimal relative speed, and it significantly influences the intensity of the polishing process. The following conditions must be met to intensify this process: the product must be entirely covered by the tool; during polishing with unchanged angular placement of axes of the product and tool, the sphere being worked must be divided into a number of circular zones and processing modes assigned based on equations presented in this article. Equations are also presented for polishing conditions for use with angular oscillation of the part relative to the tool.

Figures 4; references: 2 Russian.

[69-6508/5915]

UDC 535.345.6

DATABASE FOR DESIGN AND MANUFACTURE OF INTERFERENCE COATINGS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 13 Jul 84) pp 43-45

STOLOV, Ye. G.

[Abstract] There is a need for an information retrieval system allowing development of an interference coating for an assigned spectral characteristic, using as the database previously designed coatings to determine which of these previous designs best approximates the required spectral characteristic. Design of an appropriate database is discussed. Coatings are classified on the basis of five characteristics: coating type, index of refraction of film-forming material, index of refraction of surrounding media, incident angle of radiation, and relative width of major transmission zone. Computer memory requirements are discussed. Broad introduction of the information retrieval system suggested will allow a great savings of time and money, improve the level of design, increase the scientific and technical level of specialists working in the area, reduce the time required to introduce new technology by preventing duplication of effort and increase the timeliness of monitoring of laboratory and industrial activities. References 5: 4 Russian, 1 Western.  
[69-6508/5915]

METHODS OF CONTROLLING QUALITY OF MANUFACTURE OF CORNER REFLECTORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 12 Nov 84) pp 54-58

BONDARENKO, I. D.

[Abstract] Quality control of corner reflectors requires determination of the presence and magnitude of deviations of each of three bihedral angles between reflecting faces from a right angle, as well as curvature of reflecting and refracting surfaces. Quality control can be performed by autocollimation, interference, diffraction and photometric methods. Each of these methods is briefly described. Diagrams of required apparatus are presented. The most suitable methods for manufacturing processes are the autocollimation and interference methods, most accurate in determining deviation of angle from  $90^\circ$  and nonplanarity of surfaces. The diffraction method can be used to trace the dynamics of changes in the light returning capacity of corner reflectors. The advantages of the photometric method are that it monitors the absolute value of energy reflected by the corner reflector, allowing such defects as poor quality of reflecting faces (roughness), deviation from total internal reflection, and absorption of light by corner reflector materials to be determined. However, the photometric method cannot be used to determine the actual cause of deterioration in reflection. Figures 4; references 37: 24 Russian, 13 Western.

[69-6508/5915]

METHOD OF TRANSFORMING SYMMETRICAL TYPE OPTICAL SYSTEMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 85  
(manuscript received 6 Dec 84) pp 21-24

ZVEREV, V. A. and IVANOVA, T. A.

[Abstract] A symmetrical optical system with the diaphragm located at its center works well with magnification  $V = -1^x$ , correcting aberrations successfully. For other magnifications, the system must be transformed from a symmetrical to a proportional system to allow correction of coma, distortion and astigmatism. Proper selection of spherical aberration is also possible by selection of parameters of the initial symmetrical system. An empirical method is used to make the transformation from the initial symmetrical design to proportional design. The method, called the method of preservation of break angles of the aperture beam, is discussed in this article. The influence of the transformation on the correction of the optical system in the area of third order aberrations is described. The method yields good results in the design of photographic lenses as well as microscope objectives.

References: 3 Russian.

[69-6508/5915]

UDC 621.378.325:621.375.826

USE OF ELECTROOPTICAL MODULATOR TO INCREASE CONTINUOUS LASER RADIATED POWER STABILITY

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 85 pp 31-32

BIKMUKHAMETOV, K. A. and KIRYUNIKOV, K. V.

[Abstract] Experimental results on the use of an electrooptical modulator as a controlling element in a device for active external stabilization of the radiated power of a continuous laser are studied. The stabilization device uses a type ML-3 optical modulator. Both helium-neon and argon lasers radiating at 633 and 514 nm were tested. The stability and reproducibility of levels of radiated power are limited by the stability and reproducibility of voltage provided by a reference voltage source and the transmission coefficient of the photodetector, as well as the frequency range of operation of the stabilization device. Figures 3; references 4: 3 Russian, 1 Western.

[55-6508/5915]

UDC 535:621.391

NONCOHERENT SOURCES FOR RASTER FILTERING IN COHERENT OPTICAL SYSTEMS

Moscow ELEKTROTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 7, Jul 85,  
(manuscript received 28 Jul 83) pp 1427-1429

LAPIDES, A. A.

[Abstract] The use of coherent optical filtering with the help of Fourier filters consisting of opaque diaphragms with an elongated noncoherent white light source is designed. A Fourier slit filter employed for television raster correction is examined. It is determined analytically that coherent raster filtering of low-frequency images can be done using a completely non-coherent source. Experiments are described that show good agreement with the theoretical findings and that indicate that the proposed method has advantages over existing methods. The proposed method is simpler than the method employing a coherent light source, and does not introduce additional noise into the image. The hardware is simpler, because it places no constraints on the dimensions of the light source. Figures 1; references 14: 6 Russian, 8 Western.  
[57/6900/5915]

UDC 534.874.2.535.241.13

EFFICIENCY ANALYSIS OF MULTIELEMENT AUTOMATIC ELECTROACOUSTICAL BEAM STEERING TRANSDUCERS IN BRAGG ACOUSTOOPTICAL DEVICES. II.

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 8, Aug 85 (manuscript received 4 Jun 84) pp 1053-1064

GRIGORYEV, M. A., PETROV, V. V., and TOLSTIKOV, A. V., Saratov State University

[Abstract] The maximum attainable acoustooptical interaction efficiency is compared for existing multielement electroacoustic transducers, assuming that automatic Bragg-angle adjustment is provided in the required frequency bands. The transducers investigated represent a sequence of phased or antiphase piezoelements, as well as elements employed in multisection low- or high-pass filters. The optimal conversion factor providing the most efficient acoustooptical interaction for specified electromagnetic power is found for low- and high-pass filters. A method is proposed for finding the parameters of piezoelements and the equivalent circuit of cells providing the required conversion factors. The optimal value of the electroacoustic conversion factor of one cell in a filter-type transducer is found to depend upon the number of elements. Phased and antiphase transducers exhibit maximum attainable acoustooptical efficiency in the shortwave part of the microwave band that is two to three orders of magnitude greater than that of low-pass and high-pass filters. Filter-type transducers make it possible to achieve high acoustooptical interaction efficiency at frequencies below 3 GHz when the input electromagnetic power is reduced appropriately. Figures 2, tables 2, references 6: 5 Russian, 1 Western.

[95-6900/5915]

UDC 535.853-1.17

EFFICIENCY OF ECHELETTES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85 (manuscript received 11 Jan 85) pp 1-3

NIKITIN, V. A. and MALYY, A. V.

[Abstract] The efficiency of an echelette, defined as ratio of the energy diffracted into a given spectral order to the energy reflected by a mirror made of the same material as the echelette surface, is evaluated in approximate but simple terms rather than on the basis of rigorous theory. The spectral distribution of echelette efficiency for nonpolarized radiation is accordingly assumed to be proportional to  $\sin\pi(k-v/v_b)/\pi(k-v/v_b)^2$  ( $k$  - diffraction order,  $v_b = N/2\sin\theta$  - wave number corresponding to "brilliance",  $\theta$  - brilliance angle of grating inclination,  $N$  - number of grating lines). It has been established experimentally that the echelette efficiency  $\rho(v)$  in the first two diffraction orders and then also the degree of polarization  $p(v)$  can be accurately

calculated after  $v_b$  has been determined from known values of the two echelle parameters  $\theta, N$  and the wave number  $v_{\max}$  corresponding to the maximum echelle efficiency has been determined as  $v_{\max} = 1.1v_b$  ( $\theta \leq 25^\circ$ ) or  $v_{\max} \approx 1.4N$  ( $\theta > 25^\circ$ ). Then  $p = 1 - 0.9 v/v_{\max}$ . The accuracy of these calculations is within 5-10% for  $\theta \leq 21^\circ$ , adequate for design and performance analysis of monochromators for infrared spectrometry with any anomalies disregarded. Figures 3; references: 3 Russian.  
[89-2415/5915]

UDC 681.7.013.8

PRINCIPLES OF DESIGNING MEASUREMENT AND COMPUTATION SYSTEM FOR QUALITY CONTROL OF OBJECTIVES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 31 Jan 85) pp 3-6

VELIKOTNYY, M. A., DEMIDOV, N. V. and PETRAS, S. V.

[Abstract] A measurement and computation system on the basis of a linear transferred-charge device coupled through an analog-to-digital converter to a microcomputer is considered for automatic quality control of objectives, an objective being most completely and comprehensively characterized by its optical transfer function. The system essentially performs a Fourier analysis of the scattering function for the inspected objective. The transferred-charge device converts this function into an analog video signal and the latter is converted to a digital one for processing by the microcomputer. Measurements are made at wavelengths within the visible region of the spectrum, where the modulation transfer function of a transferred-charge device is determined mainly by the device geometry and not significantly by the diffusion of minority carriers or other losses. The mathematical model is constructed for design and performance analysis of such an inspection system, assuming that the inspected objectives are linear isoplanar ones and assuming that neither the collimator objective nor the microobjective in the inspection equipment distort the image of a noncoherent light source seen through the inspected objective. Two variants of such a system are proposed. In the first one the source of noncoherent light illuminates a knife edge in the focal plane of the collimator objective, through a condenser lens and a set of filters. In the second one there is built in a return path for the light rays, with the knife edge in the trailing focal plane of the inspected objective and with the image analyzed in the leading focal plane of the collimator objective. The algorithm of calculating the optical transfer function from the data obtained by automatic scanning includes a fast Fourier transformation, with correction for nonuniform sensitivity of and dark currents in the transferred-charge device. Figures 1; references: 9 Russian.

[89-2415/5915]

UDC 535.854

INTERFERENCE METHOD OF MEASURING DISTANCE BETWEEN SEMITRSPARENT  
REFLECTING SURFACES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 22 Jan 85) pp 13-14

SHAROV, Ye. M.

[Abstract] An interference method is proposed for measuring the distance between two parallel semitransparent reflecting surfaces. It is based on Fourier spectrometry, requires two mirrors of a Fabry-Perot interferometer etalon, a movable reflector and a cat's eye stationary one, an optically pumped laser as light source, a scanning mechanism, a white-light channel and a monochromatic-light channel. The electronic equipment includes a pulse generator, two light-to-signal converters and pulse shapers, two amplifier-receiver channels with an  $n_0$ -counter and a  $\Delta n$ -counter, a microprocessor, and a recording instrument. The measured distance is generally  $d = 1/4\lambda(\Delta n/N+n_0)$  ( $\lambda$  - wavelength of laser radiation,  $N$  - number of pulses generated between successive pulses shaped,  $n$  - refractive index of medium in which the distance is measured). Figures 1; references: 7 Russian.  
[89-2415/5915]

UDC 535.317.681.31

OPTICAL TRANSFER FUNCTION FOR CALCULATION OF ENERGY CONCENTRATION  
DISTRIBUTION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 10 Jan 85) pp 19-21

AGUROK, I. P. and RODIONOV, S. A.

[Abstract] The radial energy concentration profile in a scattering spot, definable as the fraction of total spot energy contained within a circle of radius  $r$ , is an important image parameter for the design of telescopes. It is usually calculated from the point scattering function, the fast Fourier transform of the pupil characteristic, but this requires numerical integration and thus is neither very accurate nor very efficient. It can also be calculated from the optical transfer function, the fast Fourier transform of the point scattering function. Both real and imaginary parts of that optical transfer function are calculated more accurately and efficiently, with the corresponding system of linear equations for the coefficients being solved by the method of least squares. The advantage of this approach is demonstrated on calculations for a nonaberrational instrument with a circular pupil. References 7: 4 Russian, 3 Western (all in Russian translation).  
[89-2415/5915]

PRIZ SPACE-TIME MODULATOR OF LIGHT WITH FIBER-OPTIC LEAD-IN

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 27 Dec 84) pp 24-27

BEREZHOV, A. A., BUZHINSKIY, A. A., POPOV, Yu. V. and SHERSTNEVA, T. N.

[Abstract] A space-time modulator of light has been developed which consists of a photorefractive  $\text{Bi}_2(\text{SiO}_3)_3$  crystal. Its two distinctive features are lead-in of optical signals from an Industar-50 projecting objective through a disk made of optical fiber (10  $\mu\text{m}$  in diameter) in the focal plane of that objective into the cathode-ray tube and a configuration of the optics which makes light pass twice through the 1 mm thick crystal plate. The fiber disk replaces a lossy read-in objective. The double pass provides a longer interaction and readout time. A multilayer interference coating on one surface of the crystal plate acts as selective dielectric mirror. There are two transparent  $\text{InO}_2$  electrodes (electrical resistivity approximately 100  $\text{ohm}\cdot\text{cm}$ ), one deposited on that coating and one deposited directly on the other surface of the crystal plate. There are also two metal-strip electrodes, deposited on both sides of the crystal plate around the periphery 0.5 mm from the edge. Behind the crystal is a light-splitting prism followed by a polarizer film inside a frame placed between the bonded to two protective plane-parallel glass plates. The modulator was tested, reading-in with light of a He-Cd laser ( $\lambda = 0.44 \mu\text{m}$  wavelength) and reading-out with linearly polarized light of a 5 mW He-Ne laser ( $\lambda = 0.63 \mu\text{m}$  wavelength). Optical data can be read out either by the polarization method or by the diffraction method. Figures 4; references 4: 3 Russian, 1 Western.  
[89-2415/5915]

ADAPTIVE INTERFEROMETER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 27 Jun 84) pp 27-28

GAVRYUSHENKO, B. S., KURENKOV, A. V., MOZGOVOY, V. N., NOVIKOV, V. V., SEMENOVA, G. I. and SHANIN, O. I.

[Abstract] An adaptive interferometer has been developed which operates with phase modulation and tuning to either maximum or minimum signal. The carrier frequency is far from the frequency range of measurements. The instrument includes compensation of interference with amplitudes up to  $\pm 2\lambda$  in the 0-50 Hz range and up to  $\pm 0.2\lambda$  at 600 Hz ( $\lambda = 0.633 \mu\text{m}$  operating wavelength). It consists of a Michelson interferometer with tracking for adjustment of one arm. A light splitter transmits some light from an LG-38 laser ( $0.633 \mu\text{m}$  wavelength) to that adjustable mirror in one arm and reflects some of this light to the

fixed mirror in the other arm. It also passes light reflected by both mirrors through a diaphragm superposed on a shield to an FEU-35A photomultiplier. The adjustable mirror is carried by a piezoelectric drive, a stack of disks made of TsTS-19 ceramic, with a modulating part and a correcting part. The modulating part, in response to a modulation signal from an oscillator, causes the mirror to oscillate harmonically with an amplitude of  $0.04\lambda$  at a frequency of 4.5 Hz. The phase modulation is converted into light intensity modulation and as such recorded by the photomultiplier. The photomultiplier output signal, after passage through a discriminator-amplifier, is compared with the reference signal in a synchronous detector. The detector output signal, after passage through an integrator and a high-voltage d.c. amplifier, either lengthens or shortens the correcting part of the piezoelectric drive. Adaptation based on such a feedback proceeds according to the algorithm of steepest descent. The high-voltage d.c. amplifier is special, a single-stage differential amplifier with a current generator in the emitter circuits of its KT828A reverse-conductance transistors. It has a bandwidth of 2.5 kHz. The interferometer was tested on optical surfaces under conditions of strong vibrations.

Figures 2; references 5: 4 Russian, 1 Western (in Russian translation).  
[89-2415/5915]

UDC 666.1.053.3

#### CHARACTERISTICS OF CHEMICAL INTERACTION OF POLISHING MEDIA AND BORON-LANTHANUM GLASS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 6 Dec 84) pp 31-33

YAKOVLEVA, T. P., KUDRYAVTSEVA, N. L. and KHODAKOV, G. S.

[Abstract] Chemical interaction of several polishing media and STK9 boron-lanthanum glass was studied, for the purpose of determining its effects on the polishing process, it already having been established that the microhardness of the glass surface decreases upon contact with water and polishing suspensions. As polishing media were used aqueous suspensions of  $ZrO_2$ , 70%  $ZrO_2 + 30\%$  zirconium subsulfate, 50%  $ZrO_2 + 50\% SiO_2$ , and Polirit, each in a 1:6 ratio of solid to liquid. For reference were also used pure water and an aqueous solution of  $H_2SO_4$  (pH = 3). Specimens of glass containing 41 wt.%  $La_2O_3 + 33\% B_2O_3$ , disks 75 mm in diameter, were polished manually with pecorosin as lubricant on a 6ShP-200 machine with the wheel rotating at 100 rpm under a pressure of 100 gf/cm<sup>2</sup>. The flow rate of polishing suspension was measured for monitoring its action and its use. The tailings were analyzed for boron and lanthanum content, directly in mg/l and converted to their respective oxide equivalents. The results indicate that the principal chemical process occurring at the glass surface is hydrolysis of  $La(BO_3)_2$  into soluble  $H_3BO_3$  and insoluble  $La(OH)_3$ . The polishing action was found to slow down appreciably with longer use of the same suspension and thus with increasing lanthanum content in it.

Figures 1; tables 1; references: 8 Russian.  
[89-2415/5915]

ABSORPTION SPECTRUM AND THERMAL STABILITY OF KO-818 ENAMEL COATINGS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 24 Jan 83) pp 33-35

OLEYNIKOV, L. Sh. and POLUSHKIN, Yu. I.

[Abstract] A study of KO-818 enamel coating on various substrate materials was made, for the purpose of determining its absorption characteristics in the infrared region of the spectrum and its thermal stability at low temperatures. Disks of M2 copper, LS-59-1 brass, D-16 and AMg-6 aluminum alloys, K8 glass, and KRS-5 crystal, some 30 mm in diameter and 3 mm thick, others 50 mm in diameter and 10 mm thick, were coated with 25-100  $\mu\text{m}$  thick layers of this enamel by two methods: 1) conventional technology, namely spray deposition of pulverized enamel on the substrate at 200°C with subsequent drying at room temperature; 2) plane brushing one, two, or more layers of enamel paste on the substrate at 20°C. Specimens were tested for resistance to repetitive thermal shock by immersion in liquid nitrogen and heating to room temperature as well as to slow cooling in a cryostat from 300 K to 80 K. The reflection coefficient of coatings was measured over the 2.5-20  $\mu\text{m}$  range of wavelengths with a Perkin-Elmer spectrometer and over the 20-100  $\mu\text{m}$  range of wavelengths with a Soviet-made SP-143 spectrometer, in both cases accurately within 1-2%. The coating thickness was measured with a micrometer, accurately within  $\pm 3 \mu\text{m}$ . The spectral transmission was also measured, found not to exceed 0.02 in the 2.5-40  $\mu\text{m}$  range of wavelengths and to reach 0.15 at the 100  $\mu\text{m}$  wavelength. The absorption bands were found to correspond to minima in the reflection spectrum, indicating absorption by the coating of both incident radiation and radiation reflected back by the substrate surface. According to the data, KO-818 enamel coatings of any thickness and deposited on any substrate material by any method are thermally very stable at cryogenic temperatures under any kind of load. Thick coatings, moreover, absorb infrared radiation almost nonselectively.

Figures 2; references: 2 Russian.  
[89-2415/5915]

FINE GRINDING OF FLAT OPTICAL COMPONENTS WITH DIAMOND TOOL

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 27 Dec 84) pp 36-40

GLUKHOV, Yu. A.

[Abstract] Use of diamond tools for fine grinding of flat optical components, with plane segments or large spherical ones, calls for specific improvements of the process not required for fine grinding of small spherical segments. These improvements are necessitated by the larger dimensional allowances, up to 0.2 mm on the thickness, the larger area of glass surface subject to grinding at any one time so that more force is needed for maintenance of the proper

pressure ( $1 \text{ kgf/cm}^2$ ), as well as the larger tool size and weight. It is thus necessary to improve the reliability of the diamond wheel segments, usually consisting of 150-300 grains, to increase their abrading power on hard glass, to improve the lubricant-coolant feed, and to avoid undesirable straightening or other corrective tool adjustments. The technology of fine grinding with diamond tools has already been fairly well optimized. It has been designed as a two-pass process, using 28/20 diamond micropowder on MZ-15-1,2,7 binder, depending on grade of glass and kind of surface, for the first pass and 14/10 diamond micropowder on MZ-15-5 binder for the second pass so as to minimize tool wear and maximize tool stability. The glass ingots are rough ground to a surface finish with minimum embedment depth of residual defects, minimum surface roughness, and maximum shape precision. The tools have been designed to satisfy all requirements, for the first pass and for the second pass respectively. Two types of grinding machines, series ShP and series ShA, have been designed and laid out to operate at optimum speeds and with the wheel mounted in the best position for any given operation. To this has been added a gaging and inspection system for dimensional and surface finish control.

Figures 3; tables 1; references: 3 Russian.

[89-2415/5915]

UDC 771.537.521.391

#### ESTIMATING OPTICAL PARAMETERS OF PHOTOGRAPHIC MATERIALS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 6 Dec 84) pp 43-45

BARKOV, V. I. and ALEKSEYEVA, Ye. A.

[Abstract] The reverse problem of radiation transfer, namely determining four not directly measurable parameters of a photographic medium, is solved by an approximate analytical method. These parameters are optical thickness  $\tau_0$  of the emulsion layer, albedo  $\Lambda$ , asymmetry index  $\delta$  of the scattering indicatrix, and length  $L$  of the mean free path for a photon. The solution is based on a model which includes multiple scattering and absorption of light by AgCl micro-crystals in the undeveloped layer or by grains of metallic silver in the developed layer, reflection according to Fresnel's law, and refraction at the interfaces. The first three of those parameters have been calculated on the basis of this solution, in the sixth-order approximation, for normal incidence of light on a photographic plate. A numerical solution has been obtained, assuming a refractive index  $n = 1.53$  at the gelatin-substrate interface for light of the  $\lambda = 600 \text{ nm}$  wavelength. A statistical analysis of the solution for over 1500 points in the  $\tau_0-\Lambda-\delta$  space has yielded an approximate equation, first consisting of 26 terms and then reduced to 6 terms, for any of these variables as function of the optical state in terms of three independent variables  $I_1, I_2, I_3$  ( $I_1$  - intensity of light transmitted,  $I_2$  - intensity of light diffusely transmitted at  $17^\circ$  zenith angle,  $I_3$  - intensity of light diffusely reflected at  $163^\circ$  zenith angle, all normalized to intensity of incident light). The analysis conforms to the theory of radiation transfer,

according to which the optical characteristics depend on the internal molecular structure and the phase structure with nonhomogeneity of the medium, an important parameter in this theory being the complex refractive index of AgCl or metallic silver. The obtained values of  $\tau_0, \Lambda, \delta$  for three commercial photographic materials (Foto 32, Foto 250, Type 27) agree closely with those obtained indirectly from measurements. Tables 2; references 9: 4 Russian, 5 Western (4 in Russian translation).

[89-2415/5915]

UDC 620.197.3

#### STABILITY OF OPTICO-MECHANICAL EQUIPMENT IN HUMID TROPICAL CLIMATE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 85  
(manuscript received 31 Jan 85) pp 46-48

GLAKTINOVA, N. L., IZHBOLDINA, V. I., RUSIYESHVILI, V. N., KINKLADZE, N. L.  
and TAVADZE, N. N.

[Abstract] A field study was made in the Kolkhidze test station, for the purpose of evaluating the stability of optico-mechanical equipment under conditions of the humid tropical climate in that region. This climate is characterized by a mean-month temperature above +20°C and a relative humidity above 80% over the June-September period. Two theodolites, 2T2 and T30, were tested for four years and spare parts were tested for five years, being kept outdoors for 8 h every day except during rain. They were also tested with two corrosion inhibitors for storage or transport: 1) with MGBI paper in unheated room; 2) with volatile IFKhAN-1 inhibitor under tarpauline. The first inhibitor protected equipment for two years, whereupon Aspergillus and Penicillium fungi appeared in the UT-34 hermetic sealant, in the AK-1102 white enamel, and in the electrical insulation of conductors. The second inhibitor protected equipment for four years, but stimulated formation of tarnish, also turned the color of 60M hermetic grease to brown and the color of AK-1102 enamel to yellow. Glasses K8, K108, TF4, BK10, BK110 with translucent coatings (single layer of 43R, double layer of 44R.43R), mirror coatings (25R, 3Ye, 72P), or protective coatings (70R, 1K.70R, 85N.70R) were found to be very stable. Zinc coatings and brilliant nickel or various other nickel coatings on 45 carbon steel were found to be corrosion resistant, but most of all electrolytically polished or chemically oxidized 12Kh18N10T stainless steel.

Figures 1; references: 5 Russian.

[89-2416/5915]

UDC 621.373.1.078:621.9.048.6

METHODS FOR AUTOMATIC REGULATION OF OUTPUT PARAMETERS OF OSCILLATORS  
FOR ULTRASONIC TECHNOLOGICAL PROCESSES

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 85  
(manuscript received 22 Aug 84) pp 18-21

PETUSHKO, I. V., KORICHEV, A. A. and KLYACHKO, V. M., engineers, All-Union  
Scientific Research Institute for High Frequency Currents

[Abstract] Ultrasonic oscillators produced in the USSR and abroad are compared in terms of power, working frequency, type of automatic regulation system (automatic frequency control or automatic amplitude control), dimensions, and technological application. It is found that equipment employing mechanical ultrasonic oscillations can best be made more efficient through automation by employing systems to stabilize and control the amplitude of the oscillations of the technological tool. The best automatic frequency control systems are found to be those that employ a square-wave master oscillator. The best automatic amplitude control system is that which regulates the power and the excitation circuit by changing its voltage, in the case of a class B oscillator, or by pulse width modulation in switching oscillators. Electrical bridge circuits are found to provide the best sensors for automatic regulation systems in installations for industrial use. Figures 2; references: 4 Russian.  
[110-6900/5915]

NEW ACTIVITIES, MISCELLANEOUS

UDC [621.335:625.2.012.858:538.65]:621.313.13-12

FULL-SCALE CRYOMODULE FOR ELECTRODYNAMIC SUSPENSION OF HIGH-SPEED SURFACE TRANSPORT

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 9, Sep 85 (manuscript received, after completion, 24 May 84)  
pp 79-83

BOLYUKH, V. F., graduate student, Kharkov Polytechnical Institute; BOCHAROV, V. I., doctor of technical sciences, assistant to director, Electric Locomotive Construction Scientific Research Institute; KLIMENKO, Ye. Yu, doctor of physico-mathematical sciences, scientific laboratory, Institute of Atomic Energy imeni I. V. Kurchatov; NOVIKOV, S. I., engineer, Institute of Atmoic Energy imeni I. V. Kurchatov; OMELYANENKO, V. I., candidate of technical sciences, assistant professor, Kharkov Polytechnical Institute; and SERGEYEV, S. A., graduate student, Kharkov Polytechnical Institute.

[Abstract] The results are presented of work concerned with the creation of full-scale superconducting magnetic systems for electrodynamic suspension of high-speed surface transport. Figures are shown of the following: 1) Exterior of KhPI-001 cryomodule; 2) Diagram of KhPI-101; 3) Insert of KhPI-001; 4) KhPI-101 superconducting coil; and 5) Lay-out diagram of carbon temperature-sensitive resistors, and the results of thermophysical tests of superconducting KhPI-101. Figures 5.

[109-6415/5915]

UDC 644.1:697.9

NEW TYPE OF DOMESTIC AIR CONDITIONER

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85  
(manuscript received 24 Oct 84) pp 26-27

TSIMERMAN, A. B., PECHORSKAYA, I. M., ZEKSER, M. G., engineers, MAYSOTSENKO, V. S., candidate of technical sciences, and KULIKOV, I. A. and PASHAYEV, K. G., engineers

[Abstract] A new type of air conditioner, the regenerative indirect-evaporator air cooler, overcomes the shortcomings of existing air conditioners, including high power consumption in compressor types, large size and inefficiency in evaporator types. The new type of air conditioner consists of a filter, fan

and cooling unit. The cooling unit includes a body with a base and a packing with a regular structure made of capillary-porous ribbed wettable plates, one side of which is impermeable. The plates are arranged so that they form alternating channels lined by the impermeable and porous wettable surfaces. The packing is placed in the base, which contains water. The channels with capillary porous surface are moistened, the channels with the impermeable surfaces remain dry. Outside air is fed into the dry channels, while the wet channels are sealed. At the output from the dry channels, the air is divided into two streams, one of which is sent into the area to be cooled, while the second enters the moist channels flowing in the direction opposite to the main stream of air. The water from the porous walls is evaporated, its temperature decreasing and cooling the main stream which passes along the dry side of the wall. Due to the use of a portion of the cooled air from the dry channels to flow over the wet channels, the cooling limit is the dew point of the incoming air. One- or two-stage devices can be used, depending on the climatic conditions. In two-stage devices, the second stage is one of traditional evaporative cooling, increasing the moisture content of the incoming air. The major advantages of the regenerative cooler include simplicity of design and operation, no requirement for scarce materials and low power consumption.

Figure 1, references: 4 Russian.

[24-6508/5915]

UDC 64.06:621.3:61

#### BASIC MEANS FOR DEVELOPMENT OF DOMESTIC MEDICAL APPLIANCES

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 2 Oct 84)  
pp 53-54

TER-ASATUROV, G. P., doctor of medical sciences, head of Scientific Research Laboratory of Electrical Medical Domestic Apparatus, First Moscow Medical Institute

[Abstract] Domestic medical appliances can be arbitrarily divided into three main groups: devices which influence the climate in a room (humidifiers, fans, dust traps, ionizers and air conditioners); devices which perform physical therapy procedures (massagers, ultraviolet and infrared lights, inhalers); and diagnostic devices (pulse rate and blood pressure measuring devices, thermometers, ergometers). The seriousness and social significance of the use of these devices require that their development and use be based on the requirements of medical science, their number and functions constantly expanded. The technical administration of the electrical industry ministry, USSR, has issued a coordination plan for scientific research, development and artistic design of domestic devices based on a universal electric heater and fan, a four-year program. The universal heater-fan upon which this development project is based can be used as the heating element for dry air and steam baths, vegetable and mushroom dryers, bactericidal air treatment units, drying and disinfection chambers for clothing and linens and many other devices. The first development of the project is a portable bath. The broad utilization of domestic medical devices improves the comfort of life and working capacity of the citizens,

making rest time more effective. Domestic medical devices should be developed intentionally to improve the effectiveness of traditional apparatus by the use of modern achievements of science and technology and the development of new generations of instruments based on fundamental studies of human physiology and the environment.

[24-6508/5915]

UDC [64.06:621.3]:658.512.2

DEVELOPMENT OF ARTISTIC DESIGN PROGRAM TO INCREASE QUALITY OF DOMESTIC ELECTRIC APPLIANCES PRODUCED ENTERPRISES ASSOCIATED WITH THE MINISTRY OF THE ELECTRICAL ENGINEERING INDUSTRY

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 2 Oct 84)  
pp 47-49

SEMELEV, Yu. K. and KULIKOV, I. A., engineers

[Abstract] The All-Union Scientific Research Institute for Electrical Engineering and Informelektro have concluded an agreement for a program intended to improve the quality of domestic electric appliances produced by enterprises in the industry. The project was initially hindered by the fact that there simply was no experience in the nation in the conduct of such large-scale design improvement projects. The major criterion of quality used is the response of the public in all its variety to new products. Simple unilateral planning of electrical appliances, yielding permanent designs, is not satisfactory due to obsolescence. Therefore, operations were undertaken in several areas: theoretical, methodological, planning per se, and organizational. The formation of the list and assortment of products considering trends in development of domestic life and consumer demand is one of the major theoretical problems of the program. The results of studies performed on the problem of development of the variety and assortment of domestic products are reflected in branch methodologic recommendations, intended to orient specialists in the industry toward methods and approaches of performing preplanning analysis before planning of products is undertaken. Photographs of designs of several new products are presented, including a ladybug night light, modern iron, lightweight wall-hanging vacuum cleaner, circular toaster oven, portable heated pool, and a universal heater and fan. The work performed in the industry to improve its administrative structure in the area of production of consumer goods allows one to hope that the creation of a complex program for development of domestic electric appliances closely correlated with the artistic design service will be undertaken in the near future. Figures 8; references: 2 Russian.

[24-6508/5915]

UDC [64.06:621.3].001.1

IMPROVEMENT OF FUNCTIONAL PROPERTIES OF DOMESTIC ELECTRIC APPLIANCES

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 85 (manuscript received 2 Oct 84)  
pp 50-51

SOLOV'YEV, B. L., engineer, Moscow Institute of the National Economy  
imeni G. V. Plekhanov

[Abstract] Domestic functional duties currently consume 120 billion man-hours per year in the Soviet Union, some 30 percent of the free time of the entire population. A retrospective analysis of consumer electric appliances shows that each successive generation has satisfied a broader range of consumer demands while performing the basic functions of preparing and storing food, cleaning apartments, washing clothing and dishes. The government standards used to evaluate the quality of domestic appliances do not always produce results which agree with the practical experience of users. A new standard suggested is the amount of time invested by the consumer in the performance of the functions associated with the use of an appliance. The purpose of most appliances, after all, is to minimize labor expenditure in the performance of a necessary task.

References: 4 Russian.

[24-6508/5915]

CSO: 1860

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